PUBLISHED EVERY SATURDAY BY
THE W. J. JOHNSTON COMPANY, Limited.
167-176 TIMES BUILDING, NEW YORK.
Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 28 Hathaway Building, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR $3.
(Including Postage in the U. S., Canada or Mexico.)

Address all communications to
THE W. J. JOHNSTON COMPANY, Ltd.,
Times Building, New York,
OR ANY OF THE BRANCH OFFICES.

VOL. XX. NEW YORK, NOV. 26, 1892. NO. 22.

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Wanted: An Engineering Library. WE desire to add our approval of the project now on foot for the establishment of a great library in the city of New York, and to express the hope that its shelves may contain what is now so sadly lacking in the engineering advantages of New York, or indeed of any city in the United States, namely, an adequate and comprehensive engineering library that shall be especially complete in its collection of literature on the subject of electricity. The United States needs such a library, and the need is becoming greater every year, as the business of electrical engineering becomes more extensive and the number of people interested in or dependent upon it becomes more numerous. As New York City is the centre of the engineering industries it should, more than any other city, possess such a library as we have mentioned.

Exhibits at the World's Fair. THE list of exhibitors at the World's Fair, printed elsewhere in this issue of THE ELECTRICAL WORLD, will give our readers an idea of the extent and variety of the displays that may be expected next year in the Electricity Building. These are taken from a list of prospective exhibitors in all departments of the Fair, numbering no less than 18,000 names. Very few, if any, of the large companies will be found not to have their names on the list as published, and some of these, as is well known, will make very large and comprehensive exhibits. The General Electric Company, for instance, is reported to have already opened a temporary office on the ground, which has been placed in charge of Lieut. Spencer. For authoritative information regarding the evening closing rule our readers are referred to the letter of Mr. Higginbotham printed in our World's Fair letter on another page.

Gilbert: Translation and Fac-simile. THE celebrated work of Gilbert, of Colchester, will soon be accessible to the English speaking people. The Gilbert Club, formed for the purpose of bringing out an English version of the "De Magnete," began the translation several years ago, and has certainly taken enough time to make a carefully prepared copy of the original 1600 edition. Those of our readers who made haste several years ago to subscribe and pay in advance for the promised work will be grateful for the information volunteered by an English contemporary that the translation was finished two years ago, since which date the various chapters have been under revision by the editing committee of the club, and that the revised version will now be issued "with as little delay as possible." If our English friends are impatient at the long delay of the Gilbert Club edition they may order a translation from this side of the water, for one has been made and the book issued by an American publisher. Our readers may be interested in the fact that a fac-simile reproduction of this famous and now very rare work has just been brought out in Germany.

Electrical Rapid Transit. SHOULD the Philadelphia & Reading Railroad obtain control of the franchise for the underground rapid transit road in this city, as is rumored at present, the result may prove very favorable for the development of electric railroading on a large scale. The chief idea in their getting control is naturally to obtain an advantage over their competitors by getting into and through New York with their present steam roads. The road under New York City is to be run electrically, while the railroads to and from the city—which will presumably be connected with it underground—will use steam, as they will be the terminals of the present steam roads. Electricity and steam will then be run under the same management and under about the same conditions in tunnels, and it will therefore be an excellent opportunity to compare the two, both in the first cost of their respective tunnels and, to a certain extent, in the cost of operation. The objections to having smoke producing locomotives in these long tunnels will then become very apparent in comparison with the smokeless electric cars, particularly when, as will be the case here, the trains would start and stop and, perhaps, be flagged, while in the tunnels or in mere enlargements of them. The objections to being half-smoked in these tunnels will go a great way toward balancing the advantages of gaining a little time and avoiding the use of the ferry. The fact that there are much longer tunnels in use already in which the smoke is not noticed does not apply to these, as the conditions are not the same. In the former there is generally a natural draught, while in these it will be very difficult, if not impossible, to have any such natural ventilation, and the smoke which will accumulate will soon make itself objectionable. It is not unlikely, therefore, that if this steam road obtains control of the underground franchise, attempts may be made in earnest to at least change over from a steam to an electric locomotive to draw the trains of the present steam roads through the tunnels. This would then give the electric locomotive for heavy work a good opportunity for a fair trial without being handicaped by endeavoring to do too much at once in not only replacing the present steam locomotive, but doubling the speed at the same time, as is often proposed.

Rapid Transmission of Mails. THE problem of the best and most efficient method for the transmission of mail and express matter at high rates for speed is one that "will not down." It is one that is continually coming up for discussion among men interested in securing the most satisfactory means of furnishing the most rapid and, at the same time, the most modern service that can possibly be devised. The great need of better service in this respect is apparent to all. The transportation of the tremendous volume of foreign mail arriving in this city each week across Manhattan Island by the primitive horse-and-wagon method; the slow transportation of mail matter between the main offices of such business centres as New York and Brooklyn, Boston or Philadelphia and even between the main office in this city and its principal railroad depot at Forty-second street, are examples of service that are urgently demanding the application of better and more satisfactory methods. In Chicago the same need has been expressed for the transportation of mail from the centre of distribution at the main post office to the sub-station on the World's Fair grounds. A service which requires nearly as much time to transmit a letter for the last three, four or five miles of its journey as for the entire remainder of its trip, it may be for 250 or 300 miles, is one which will not long be tolerated in these days of "fast" mails and rapid transit. Let such service as that promised by the Portelectric system, whether carried out by that method or any other, be once put into actual operation in the transmission of mail and small parcels between two such centres as the post offices of New York and Brooklyn, and be shown to be practicable and that it offers an opportunity for a profitable investment, and the public will demand its introduction in a hundred places where the service is now so poor and inefficient. It is highly probable that the first to engage in an undertaking of this kind will be either the Post Office Department of the government or some railroad company already possessing the right of way that would permit the construction of an additional track for this purpose without the acquirement of further property rights. Any of the railroad lines between New York and Philadelphia, for instance, could construct and operate a line of this kind, when one shall be presented that appears practicable, at a minimum of initial expenditure and a maximum of net earnings.

Even the Clouds Don't Escape Him. THE advertising dodge fiend, not being satisfied with the earth, to disfigure with his unsightly signs, has taken a step in another direction, and is about to go where advertising space is free to all and no privileges have to be asked and paid for. No laws exist there to bind him, and he can desecrate unoccupied space by the square mile to his heart's content, while everybody within miles will be bound to notice his advertisement, and, as he says, "enjoy reading it." This new dodge, to utilize the under side of a cloud for advertising space, although suggested some time ago, is just now being tried in England with "great success" and "great prospects;" the experimenters feeling very proud in having "accomplished this surprising scientific feat," and calling it "celestial advertising." An English newspaper in speaking of it says indignantly, "an apparatus is positively in course of construction by which the clouds are to be turned into hideous and gigantic boardings. This awful invention deprives us of the last 'open space' in the world on which the weary eye might rest in peace without being agonized by the glaring monstrosities wherewith the modern tradesman seeks to commend his wares." We are told that portraits, drawings and figures, with and without colors, will be projected upon the innocent mists of heaven upon such a scale that all will be able to "enjoy the novelty." As in many other cases electricity has been the means by which this has been made possible. While we regret to see a new accomplishment thus misapplied, yet the invention itself is not without interest from a scientific standpoint. It consists apparently of producing letters, words and pictures from a sort of "magic lantern" with a very powerful electric light, using the clouds as a screen. The fact has long been known that lights can be produced on the clouds so as to become visible for miles around. Vessels skirting the coast, although at great distances, can sometimes see the locations of the towns at night quite distinctly by the illumination of the clouds above them. It has also been suggested a number of times to throw the light from lighthouses up on to the clouds, as it is then more easily seen under certain conditions of weather, especially during fogs. It was proposed also to use this as a ready means of signaling between two distant stations, as, for instance, in war or at sea. To focus a translucent object on a cloud as a background is therefore only another step, but it is nevertheless very interesting to know that it has actually been done. There seem to be several experimenters at work on this invention in England. One of them succeeded in producing the letters B U F on the clouds, the unaccommodating cloud being presumably not large enough to take in the other part—"falo Bill's Wild West," which was being advertised. But if the statements of the electricians who are experimenting with it are reliable, they will no longer be outdone by such a small matter as the insufficient size of a cloud or even by its total absence, as they have succeeded in making artificial clouds to order, and to use another beam of light as a background. Even portraits are said to have thus been "placed" on the clouds, though the report does not say how great the resemblance was. That the invention can be made very useful for other purposes than advertising there is no doubt, and we are therefore pleased to hear of its success. It is interesting to notice in this connection that the English papers which are always ready to claim for the Englishmen priority of invention over Americans, in case the invention is of importance, appear in this case to be quite willing to give the Americans the credit, as it is such an "atrocious way of advertising."

Rumor that the General Electric Company Will Back the Chicago & St. Louis Electric Railway.

As we go to press a very important announcement is made by the Dow Jones Company, in its financial news bulletins under the head of "Sensational Movement." It is as follows:

We are told by a good authority that the General Electric Company has decided to identify itself with the Chicago & St. Louis Electric Railway enterprise, projected by Dr. Wellington Adams. It is said that the recent issue of $6,000,000 5 per cent. debenture bonds by General Electric was to raise funds for this purpose.

Dr. Wellington Adams made a recent trip East, and it is known that he held conferences with General Electric officers, both in New York and Boston. Upon his return to St. Louis he said to a reporter: "Our finances are in excellent shape. I made a deal on my last trip East that has put all worry about finances out of the way."

The road has been surveyed from Chicago to St. Louis in a bee line, 250 miles long. It is designed to be constructed of four tracks, two of which will be for express business. It is said that a maximum speed of 100 miles per hour will be developed. Construction has begun. The promoter expects to have the line ready for the World's Fair business.

The stock is on the market. It consists of $7,000,000. Payments will be made as follows: 20 per cent. on application, 30 per cent. on allotment and 50 per cent. 30 days thereafter.

General Electric officials all along have been very reticent relative to the expenditure of the $6,000,000, and are even more reticent relative to the project under discussion.

A capitalist prominent in electrical affairs, while not having heard of General Electric's identification with the line, said that should the large electric companies become convinced that the enterprise had reliable backing they would make a strong fight for the equipment. He thought it possible that the General Electric Company might find it desirable to back the enterprise in order to secure the business, and at the same time a controlling interest in the road. He regarded a speed of 100 miles per hour ahead of electrical propulsion of the present day.

An experienced railroad man and financier said: "If General Electric goes into this enterprise it will wreck the company. I can see how the company might be willing to equip any of the half dozen lines now in operation between these two cities. I cannot see the sense or possible profit in building a new line as an experiment."

A leading house says: "The effect on the stock would be of a bull order. The public has been selling upon the belief that if the company needed $6,000,000 it was not in as excellent condition as had been represented. A utilization of this money for a new enterprise would dispel doubt and boom the stock."

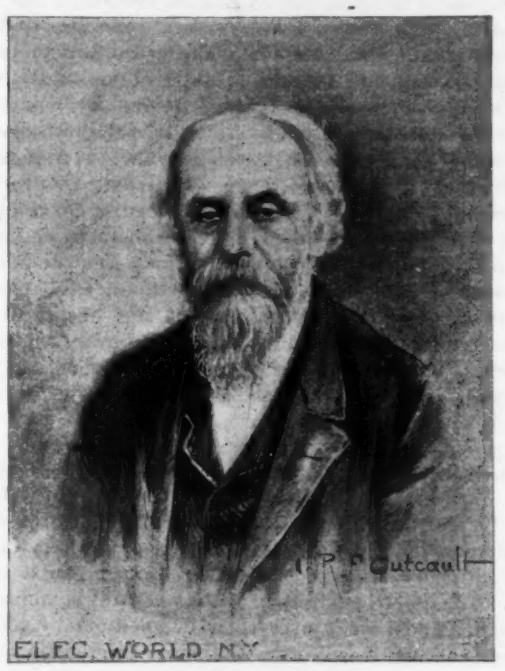
The railroads which would be most seriously affected are Chicago & Alton, Atchison, Illinois Central and Wabash.

The above information reached us too late to enable us to make any comment upon its bearing, if it should prove to be true, on the electrical industry in general or upon the project of Dr. Adams. By the time our next issue goes to press we may expect explicit information with something more than the opinions of brokers and financiers.

The Work of Samuel Alfred Varley.

A number of English electricians have lately interested themselves in the work of securing for Mr. S. A. Varley some substantial recognition of his services to electrical science. The movement has resulted in the appointment of a voluntary committee whose members are endeavoring to bring about the co-operation of the entire profession in this most commendable undertaking. A brief sketch of Mr. Varley's career will serve to show what signal services he has rendered to the cause of electrical science, and the honor his discoveries have conferred upon his native country.

Mr. Samuel Alfred Varley was born in London in 1832, and was the third son of the late Mr. Cornelius Varley, an active scientist and artist, and one of the founders of the old Water Color Society, now the Royal Institute. At the age of 14 Mr. Varley commenced to study chemistry and attended every scientific lecture he could obtain access to. In 1849, in conjunction with his elder brothers, he made numerous experiments, constructing with his own hands some hundreds of battery cells, but the troublesome manipulation attendant on their use caused him to turn his attention to magnetism. In 1852 Mr. Varley entered the service of the Electric Telegraph Company, and assisted in some experiments on retardation of electric signals through underground and submarine circuits, which led to the development of his elder brother's (C. F. Varley) double current system. In 1854 Mr. Varley was appointed to the charge of the telegraphs of the Liverpool district. About this period he constructed an electric chronograph, to measure the small intervals of time occupied by the passage of the electric signal to time balls and the time lost in the discharging apparatus. In the spring of 1855 Mr. Varley was appointed to the charge of the first field telegraphs used in war, and proceeded to the Crimea. After the fall of Sebastopol he took charge of the submarine telegraph connecting Constantinople and Varna. In 1858, when the Atlantic cable was being constructed, he wrote a paper, read before the Institution of Civil Engineers, "On the Electrical Qualifications Requisite in Long Submarine Cables," and was shortly afterward elected an associate member of that Institution. In the paper referred to above, Mr. Varley opposed the views of the electrical advisers of the company. Faraday, who had publicly supported their opinions, indorsed Mr. Varley's ideas immediately after receiving a copy of his paper. Mr. Varley followed this up by reading a second one before the Society of Arts in 1859, "On the Practical Bearing of the Theory of Electricity to Long Submarine Telegraphy." In this paper he suggested, among other things, the use of artificial lines, which have since proved of such value in connection with duplex working. In 1866 Mr. Varley discovered for himself the reaction or self-exciting principle, and at that early date constructed his first machine of the pure dynamo type which is now in the Museum at South Kensington. His dynamo of 1866 was exhibited at the Inventions Exhibition of 1885, and for this he was awarded a gold medal. The controversy which subsequently arose on this invention may be held to have been fitly summed up by the late Robert Sabine, C. E. (son in law of Sir Chas. Wheatstone), in the following words: "Prof. Wheatstone says he was the first to complete and try the reaction machine. Mr. S. A. Varley was the first to put the machine officially on record in a provisional specification, dated Dec. 24, 1866, which was, therefore, not published until July, 1867. Dr. Werner Siemens was the first to call public attention to the machine in a paper read before the Berlin Academy on Jan. 17, 1867." In 1866 he introduced needle telegraph coils, in which soft iron magnetically induced needles were substituted for tempered steel needles. These induced and consequently undemagnetizable needles entirely superseded the old form introduced by Wheatstone and Cooke, and were largely adopted by the Postal Department. In the same year (1866) he designed a system of electric train intercommunication. In the year 1875 Mr. Varley became assistant manager of the works of the late British Telegraph Manufactory (Limited); and as the first Gramme machines constructed in England were manufactured by this firm, he had ample opportunities of studying the characteristics of both series wound machines and those having a separate armature for excitation of the field magnets. There is scarcely a doubt that Mr. Varley's investigations at this period led to the invention of compound winding, for in 1876 he patented a series shunt or compound wound dynamo, and, in three legal suits, the claim that this specification first described a system of compound winding has been fully sustained. Mr. Varley has from time to time contributed papers read at the meet-



Samuel Alfred Varley.

ings of the British Association, among which may be mentioned one "On the Mode of Action of Lightning on Telegraph Circuits," wherein he describes a lightning bridge designed by himself, a number of which are now doing duty, although fitted up more than twenty years ago.

But Mr. Varley's magnum opus is the important part which he took in the invention and perfecting of the dynamo, perhaps the most striking invention of the century, and upon this his fame as a patient, conscientious and earnest scientific investigator of the Faraday school will permanently rest. His researches were undertaken in the true spirit of science, and no thought of self-emolument has ever caused him to deviate from the path which he has pursued throughout an eventful, although eminently simple and blameless life, a life in which self-denial and self-sacrifice have had no small share. Like many men of genius he was far ahead of the times, and has lived to see others reap the benefit of his great discoveries. His nervous and retiring disposition has for years kept him from the busy haunts of men, and to the younger generation of electricians he exists only in name—a name, however, that will live as long as the dynamo is employed in the service of man.

The Edison Lamp Patent Suit: A Preliminary Injunction Granted Against the Sawyer-Man Company.

The Edison Electric Light Company and the Edison General Electric Company, through their attorneys, appeared before Judge Lacombe in the United States Circuit Court last week and asked for a preliminary injunction against the Sawyer-Man company to restrain it from manufacturing or selling incandescent lamps in infringement of the Edison patent.

The action is virtually a reopening of the fight between the electric companies, which resulted a short time ago in a victory for the Edison interests, but it is to be fought out this time on different grounds. That decision was rendered against the United States Electric Light Company. Since this judgment, so the plaintiffs in the present action allege, the United States company has gone out of the business of making incandescent lamps, but it has turned all its interests in this direction over to the Sawyer-Man company another branch of the Westinghouse company. This latter corporation is now making all the lamps for the other Westinghouse companies, it is alleged, and the Edison people ask that the Sawyer-Man company be enjoined from following this course until the case may be heard on its merits in a suit for a permanent injunction and an assessment of damages.

The defendants do not deny the validity of the Edison patents, nor do they question the soundness of the decision of the Circuit Court of Appeals. They allege, however, that it would be against the best interests of the community to compel the Sawyer-Man company to give up the manufacture of incandescent lamps at once. They ask for time to wind up their business in this direction, and also an order compelling the plaintiffs to agree to sell them incandescent lamps at the regular market price.

It is also alleged that the plaintiffs have no standing in court, being in fact a most vicious trust established in violation of the laws of the State of New York, and determined to restrict trade. In his affidavit George Westinghouse, Jr., said that the General Electric Company "intends to make use, if possible, of the recent decision of the Court of Appeals in the suit of the Edison Electric Light Company in such a way as to injure the business of the Westinghouse company in the manufacture and sale of dynamo machines and other electrical apparatus, besides incandescent lamps, and to endeavor to obtain through its control of the Edison lamp patent, upon which the said suit was brought, a monopoly of all the apparatus used for incandescent lighting (of which the incandescent lamps themselves form only a very small part), by enjoining other manufacturers of incandescent lamps, and refusing to sell its lamps except for use with generating plant of its own manufacture." As an illustration of this fact Mr. Westinghouse rehearsed the efforts of the different companies to secure the contract for furnishing the incandescent lighting of the World's Fair at Chicago.

In substantiation of these statements of the methods pursued by the Edison companies the defense attaches a copy of a "Circular to Agents" claimed to have been sent out by the General Electric Company in which they outline a plan for compelling every electric lighting company in the country to put in its apparatus and tear out all apparatus built by competing companies.

The preliminary injunction against the Sawyer-Man company was granted by Judge Brown. The injunction was stayed, however, until Dec. 6, or until such other time as the matter may be brought up before the United States Circuit Court of Appeals for decision. The injunction is a mere formality, intended to push the case along toward a final decision as rapidly as possible, and it was granted in the form stated on the suggestion of Judge Lacombe, to whom the original application was made. Judge Lacombe himself was prevented from signing the order because such a signature would have disqualified him from sitting on the case when it comes up before the Circuit Court of Appeals, of which he is a member. Both sides to the controversy, it is said, are anxious to have Judge Lacombe act on the case because of his familiarity with electrical matters.

The Financial Results of the Frankfort Exhibition.

A preliminary account as to the financial results of the electrical exhibition at Frankfort-on-the-Main was issued at the end of last December, and the managing committee has now handed in a more complete report. The total amount disbursed was $322,000, of which $167,500 were upon the buildings and $154,500 on general working. As the expenses had been calculated to attain $274,300, the additional outlay came to $47,700, of which $18,000 devolved upon the buildings, and $29,700 on working expenses. The preliminary estimate by the Imperial postal authorities for the erection of the Lauffen-Frankfort line was also greatly exceeded. The first estimate by the Imperial Chief Postal Administration, for that part of the installation to be put up on the Imperial telegraph district, amounted to $5,100; the second to $10,900, and the third to $14,350; while lastly, $17,600 had to be liquidated by Frankfort. The portion of the line in Wurtemberg, estimated to cost $1,460, was only exceeded by about eight shillings. The amount to be paid toward the Lauffen line by the exhibition was $22,000, but from this had to be deducted $12,550 which had been contributed in various quarters; thus the exhibition actually only had to hand over the sum of $9,450. The total expenses of the Test Committee had been estimated at $6,800, to which the Society of German Engineers had contributed $487.

As to the receipts, the report stated that only in a few instances had the amounts of the estimates not been realized, while in various other cases much higher receipts were obtained than had been expected. The total income amounted to $346,000, thus having as against the outlay of $322,000 a balance of $24,000. The committee proposed, in accordance with an agreement with Herr von Miller, to hand over to him 15 per cent. ($3,560) of the balance, as compensation for his disbursements, and to devote half of the surplus of $20,440 toward repaying the subsidies, amounting in all to $13,130, while the other half of the surplus would be utilized in helping to reimburse the exhibitors for $43,800, which they had paid for space and power.

Electricity at the World's Fair.

(From our Special Correspondent.)

HE prospective exhibitors who have had their plans disconcerted by the alarming statements sent broadcast in the selfish endeavor to gain a little prominence may find consolation in the following correspondence:

CHICAGO, Nov. 16.—Col. R. C. Clowry—Dear Sir: I am in receipt of your communications, 11th and 12th inst., inclosing protests against the closing of the Fair at 7 o'clock, and in reply beg to say that it is not the intention of the management, either in the directory or the commission, to close the Fair so that evening sessions may not be had.

It was thought best to make the rule to close at 7 o'clock, and then the Council of Administration could, from time to time, open the gates till 8 o'clock in the evening on such days as it is thought wise to do so, it being the intention to have an evening session from 8 until 11 o'clock on from three to six days each week, according to circumstances. Kindly communicate the intention of the management, as expressed above, to the protestants, and, if you think best, have the same published in such electrical publications as you may think wise, and oblige, yours very truly,

H. N. HIGGINBOTHAM.
Chairman Council of Administration.

There is another point that the electrical fraternity ought to bear in mind. That is, that the Electrical Department of the World's Columbian Exposition is moving on to a grandly successful opening worthy of an industry that has drawn $700,000,000 of capital from other lines of commerce within the short space of twenty years. And this success is in no way dependent on the efforts of a half dozen or more disgruntled individuals who are endeavoring to win converts to their method of looking at the good work that has already been accomplished; and exhibitors who are induced to withdraw their applications for space, because of rumors false on their face, will receive no sympathy from the successful workers.

Probably the next sensational article that will appear in some of the papers will be in regard to the charges made for electric and steam power; but our readers will remember that these matters are in the hands of business men who will keep good faith with prospective exhibitors, and no doubt furnish the power free for all exhibits that are simply kept in motion without doing work. Where work is being done both electric and steam power will probably be charged for in proportion to the quantity used and not for the entire period, irrespective of whether the machinery is in motion all the time or but a portion of the time.

Souvenir Coins.—The Electrical Supply Company, of Chicago, offered $1,000 for the first souvenir half-dollar struck off at the mint, but this offer has finally been increased to $10,000, a certified check for which amount has been deposited by the Remington Typewriter Company. There are a few souvenir coins that can be secured at one dollar each by addressing the World's Fair officials at the Rand-McNally Building, Chicago, and it is unnecessary to pay the price of two dollars, at which the coins are now being offered by a New York paper.

The only advertising on the grounds will be found in the interior wall space of the toilet rooms. This concession was one of the first granted by the World's Fair officials, but they have since endeavored to re-purchase it so as to exclude advertising of any nature from the grounds. Some idea of the value of this space may be inferred from the fact that one firm pays $25,000 for space in every toilet room, and another firm pays $12,500 for smaller space. While we seriously doubt the efficiency of this mode of advertising in proportion to its expensiveness, yet we believe it due to our advertisers to inform them that there is space vacant in the toilet rooms of the Electricity building, if applied for immediately, to J. B. Clow & Son, corner Lake and Franklin streets, who control this concession.

The council at its meeting yesterday practically decided not to let an additional concession for running electric cab boats on the lagoons. The argument advanced was that with the concession already granted for electric launches there would be no room for other boats to touch the landings without interfering with the concession granted the New York Electric Launch Company.

The work of preparing the catalogue of the Exposition will devolve upon Maj. Handy, of the Department of Publicity and Promotion. A bureau will be formed for this purpose.

A general division of trade journals has been added to the Department of the Public Press of the World's Congress Auxiliary and a committee of arrangements appointed, of which J. F. Waggoner is chairman.

The Jackson-Sharpe company, of Wilmington, Del., has entered, as transportation exhibits, 65 open passenger cars to be operated on the intramural railway on the Exposition grounds. Eighteen of these will be equipped with electric motors.

F. DE L.

The Electric Subway on the World's Fair Grounds.—I.

BY FRED DE LAND.

When the gates of the World's Fair are formally opened there will be no overhead electric wires to mar or destroy the artistic harmony that, with two or three exceptions, prevails throughout the grounds. So, in planning the extensive electric service that will be afforded, ample ways and means had to be provided for properly taking care of wires for arc lighting, for incandescent lighting, for power circuits, and for the electric fountains; for the long distance telephone system, for the local telephone exchange and for the district messenger service; for the Western Union telegraph and for the Postal telegraph lines; for a police signal and a fire alarm signal; and, finally, to supply a number of subsidiary ducts for local service.

The general route of the telephone, telegraph and signal service wires was quickly planned, and pump log duct lines assigned for each class of wires. For this work over 100,000 feet of six-inch pump logs were buried where they would do the most good; in many cases two to six or eight sets of pump logs being placed in the same narrow trench, that was opened to a depth of two feet below the surface.

The next important step was the locating of the main feeders for the light and power circuits, and after thoroughly examining the scope of the work and the location of the main buildings, Mr. Frederick Sargent devised a plan that met with approval, was adopted, and is now ready for service. One view of this subway was given in THE ELECTRICAL WORLD of July 16, 1892, but some further details of the completed subway will be of interest. Briefly it consists of a main subway, built of 2-inch tarred planking spiked to 3 × 8 inch timbers set 12 inches apart, affording an interior 6 feet 6 inches square that is rendered comparatively fire proof by a coating of cement an inch in thickness forming an artificial plaster board that is supported on expanded metal lathing. This main subway, the top of which is covered by an average depth of 20 inches of soil, commences at a point underneath the power plant in Machinery Hall, continues thereunder nearly 350 feet, and then extends north 1,075 feet to a point near the Electricity Building, where the double subway ends, one section passing 292 feet under that Building, while a branch of that section passes to and under the Mines and Mining Building, a total distance of 320 feet to the west. The other section passes 160 feet to the bridge, near the southeast corner of the Electricity Building, and has a total length of about 1,900 feet.

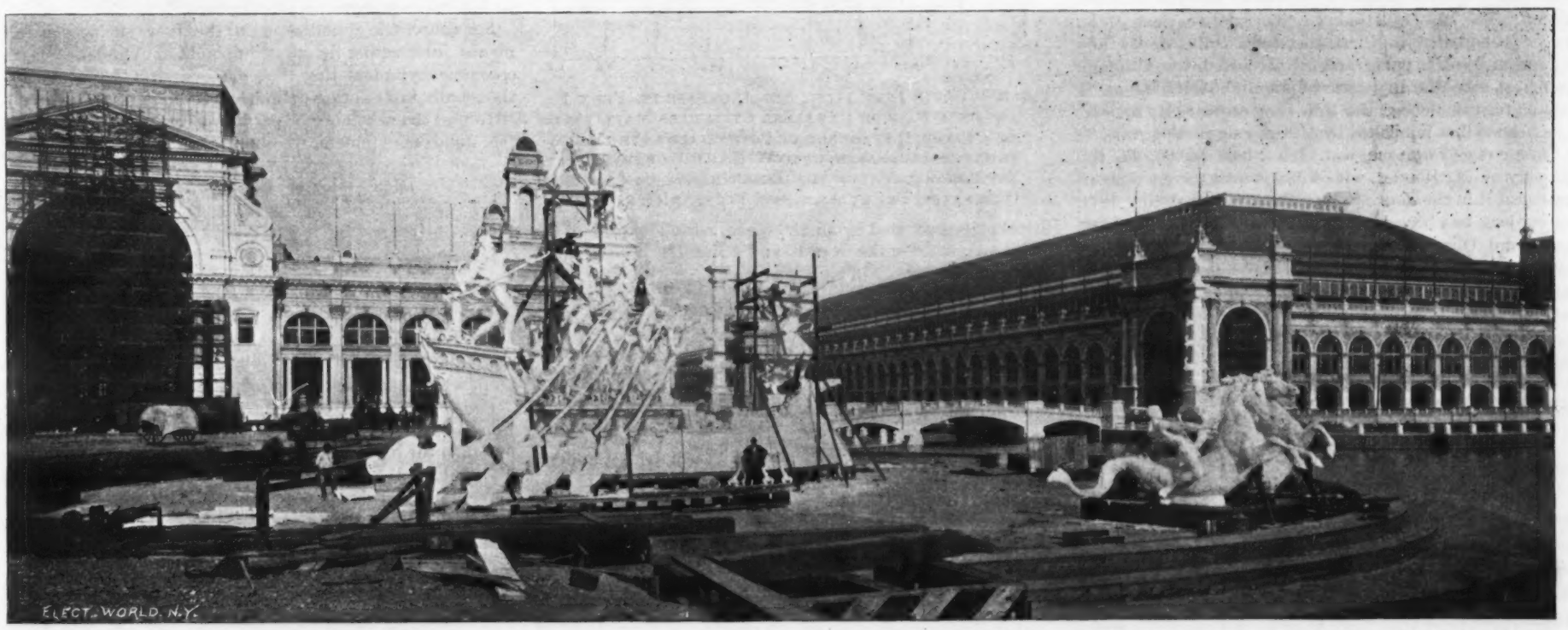
This subway may be likened to a long narrow shaft, but it is not a straight shaft by any means, curving around the heavy foundations and passing along a route least liable to interfere with work previously planned. In appearance it resembles a long plastered, unwhitewashed hallway, but from each wall, at the distance of every 30 feet, project one above the other out to a distance of 2 feet 3 inches twelve unpainted cross arms, each holding five locust pins that support the Pierce heavy double-petticoated glass insulators designed to hold two wires each. The cross arms are of oak, 2½ × 4 inches, and are driven to the extent of 7 inches, then wedged within the sockets of upright cast iron frames that are bolted to the timbers, thus affording a strong support. In the main subway the plaster work has been so well done that no moisture has found its way through, but in the branch extending to the Mines and Mining Building the seepage will be an unpleasant feature until the new drainage system is installed. Throughout its entire length the subway is lighted by 110-volt incandescent lamps of 16 candle power, placed five in series across the power circuit carrying a 500-volt current, the lamp sockets being suspended from the ceiling to which the special glass insulators supporting these two circuit wires are attached.

The main entrance to the subway is in Machinery Hall, directly north of the space occupied by the big Westinghouse dynamos. The left hand subway leads to the Electricity Building, with a double set of cross arms, but just before reaching that structure a narrow branch extends to the Mines and Mining Building, with one set of twelve five pin cross arms, into which entrance is secured through a trap door in the floor that is reached with the aid of a short stepladder. From the right hand subway there is no exit from the first section other than the entrance at Machinery Hall and through manholes, as it terminates at the bridge, where it branches out in a "V" shaped form corresponding in width nearly to that of the bridge, under which the wires are carried from off the 24 short cross arms to 12 ten-pin cross arms that are supported between the bridge trusses in iron sockets bolted to the latter. This arrangement leaves an open but protected air space affording perfect ventilation, and also enables visitors passing under this bridge in electric launches to note the number and size of the electric conductors.

At the opposite extremity of the bridge, which is 120 feet in width, the funnel-shaped extension narrows down to the standard width of 6 feet 6 inches and extends 334 feet to the Manufactures Building, where it turns and is carried in a straight line 1,690 feet to the north beneath the portico in front of the west side of that building, then 281 feet along under the north portico and across to the United States Government Building, 421 feet under that building, and to the bridge 92 feet distant, making a total length for this second section of the main single subway of 3,808 feet. The entrances, aside from the manholes to this section of the subway are through the Manufactures Building and the Government Building, access in each case being secured through two trap doors in the flooring of either of these buildings. As 60 wires branch off through laterals or ducts between the bridge and the centre of the Manufactures Building, from that point the number of cross-arms is reduced and those used project but from one side, while after leaving the Government building the number of wires is reduced to 40, and the subway ends at the Fisheries Building. From thence, and also from other points, wires are to be carried beneath the superstructure of the elevated electric railway. Vitrified tile 4½ inches in diameter is used wherever wires enter buildings from the pump logs, the tile being curved to suit the respective cases. Over 1,500 manholes are in service, distributed at various points within the grounds.

The largest feeder wires are 0000, though the power circuits may be run up to one million circular mils built up of these wires, while the other sizes range down to No. 8 B. W. G., rubber-covered, of one-half inch outside diameter for subway and elevated structure work and of lead-covered (⅝ inch, rubber insulation ¼ inch) for pump log service.

(To be continued.)



A VIEW ON THE WORLD'S FAIR GROUNDS, SHOWING THE LARGE FOUNTAIN AT THE SOUTHERN ENTRANCE OF THE ELECTRICITY BUILDING.

The Problem of Eccentric Cylinders.

BY A. E. KENNELLY.

Having given the electrostatic capacity of a condenser formed by two long parallel cylinders, one fitting concentrically within the other, and separated by a dielectric, such as an india-rubber covered wire sheathed in lead, how will the capacity vary when, still remaining parallel, the cylinders are rendered eccentric by separating their axes?

The answer to this question of electric displacement will apply, as we know, to the flux of heat, of magnetism, and of electricity through conducting media also; all these fluxes being analogous in their quantitative relations to the movement of incompressible fluids, so long as the fluid molecules advance shoulder to shoulder, or in more conventional language, move irrotationally. Our problem, therefore, broadens into this: Given the flux of electric displacement, electricity in motion, magnetism, or heat, between

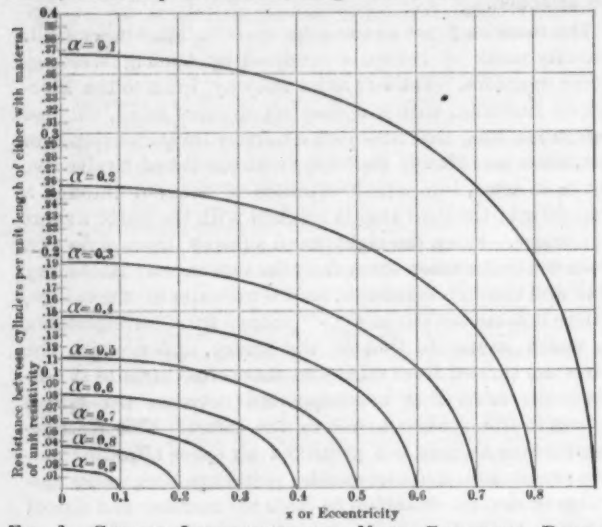


FIG. 1.—CURVES INDICATING FOR NINE CYLINDER DIAMETER-RATIOS OR VALUES OF $\alpha = r/R$ THE VARIATION OF RESISTANCE INCLUDED BETWEEN THE CYLINDERS PER UNIT LENGTH OF EACH WHEN THE ECCENTRICITY IS VARIED. ORDINATES, RESISTANCE; ABSCISSÆ, ECCENTRICITY.

concentric parallel cylinders maintained at a fixed difference of potential, how will the flux vary as cylindric eccentricity is introduced?

The answer to this question is comparatively simple, and yet it does not appear in any of the text-books with which we are familiar, probably because the demand for its employment has not been judged sufficient to warrant its introduction. The raw material for the construction of an answer is supplied in Clerk-Maxwell's "Electricity and Magnetism," vol. i., paragraph 189, second edition, although at a first glance the application may not be self-evident. A formula for calculating the effect of eccentricity appears to have been first published by M. Gaugain in the *Annales de Chimie et de Physique*, vol. lxiv., 1862, p. 203, on the authority of M. Blavier, who subsequently gave a demonstration of it in the *Journal de Physique*, vol. iii., 1874. The subject has been incidentally treated by Profs. Carey Foster and Oliver Lodge in an admirable paper "On the Flow of Electricity in a Uniform Plane Conducting Surface," appearing in the *Philosophical Magazine* for 1875,

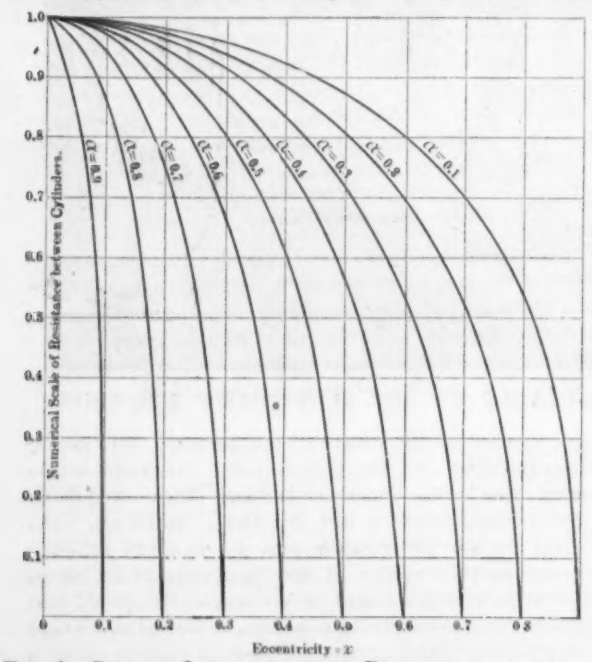


FIG. 2.—CURVES INDICATING THE DIMINUTION OF RESISTANCE BETWEEN CYLINDERS AS THE ECCENTRICITY INCREASES. ORDINATES, RESISTANCE; ABSCISSÆ, ECCENTRICITY.

vol. xlix., with an unfortunate, yet fortunately evident misprint, in the principal equation (11), p. 455. The arithmetical work embodied in these formulas is in all cases somewhat lengthy, and it is the object of this article to expose brief tables and a series of curves from which the answer to any such problem can be generally found by direct inspection, when the ratio of the cylinder diameters does not exceed 10, the more common event. There can be little doubt that such questions do occasionally present themselves in practice.

A brief outline of the theory may be permitted by way of an introduction to the tables, referring all further inquiries to the above mentioned papers. Their perusal will, it is believed, well repay the unfamiliar reader with the interest of the subject.

Let B and A, Fig. 4, be the sections of two infinite parallel concentric cylinders whose axes are at O, and whose radii are R and r respectively. If A and B are maintained at a fixed difference of $\left\{\begin{matrix}\text{magnetic}\\\text{static}\\\text{galvanic}\\\text{thermal}\end{matrix}\right\}$ potential V, and the intervening space be filled with a homogeneous material of resistivity ρ, the resistance S of this space per linear centimetre of cylinders will be $S = \frac{\rho}{2\pi} \log_\varepsilon \frac{R}{r}$

The flux per linear cm. will therefore be

$$F = \frac{V}{\frac{\rho}{2\pi}\log_\varepsilon \frac{R}{r}} = \frac{2\pi V}{\rho \log_\varepsilon \frac{R}{r}} \left.\begin{matrix}\text{in galvanic,}\\\text{magnetic,}\\\text{or thermal}\end{matrix}\right\} \text{units.}$$

In the electrostatic case, the displacement-flux, or charge per cm., will be 4π times less, or $\frac{V}{2\rho \log_\varepsilon \frac{R}{r}}$ and since the capacity is the flux for unit V, we have $c = \frac{k}{2 \log_\varepsilon \frac{R}{r}}$

where c is the capacity per cm. of cylinders in electrostatic units, and $k = 1/\rho$, the specific inductive capacity of the dielectric.

In the thermal case V will be expressed in degrees centigrade, ρ will be the thermal resistivity of the material, and F will be the flow of heat across each centimetre length of cylinders, in therms, or water-gramme-degrees-centigrade. If V be electric and expressed in volts, ρ the electric resistivity in ohms per cubic centimetre, we obtain F. in ampères by the same formula $F = \frac{2\pi V}{\rho \log_\varepsilon \frac{R}{r}}$, and lastly if V be magnetic potential between two concentric cylin-

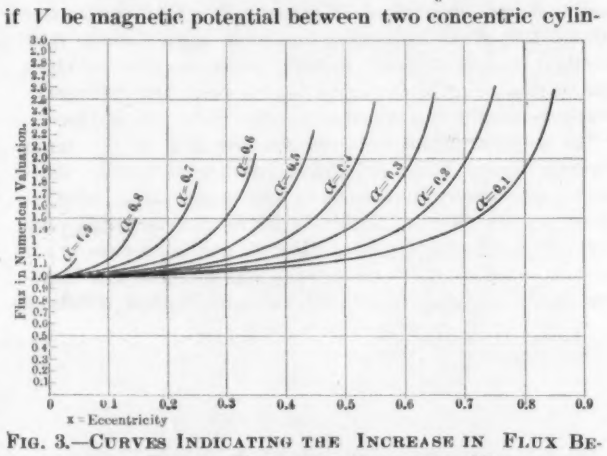


FIG. 3.—CURVES INDICATING THE INCREASE IN FLUX BETWEEN A PAIR OF PARALLEL CYLINDERS MAINTAINED AT A FIXED DIFFERENCE OF POTENTIAL, AS THE ECCENTRICITY IS INCREASED, UP TO WITHIN 0.05 OF THE GREATEST POSSIBLE VALUE THE ECCENTRICITY CAN ASSUME. ORDINATES, FLUX; ABSCISSÆ, ECCENTRICITY.

drical poles separated by an air space, with V expressed in electromagnetic units, $\rho = 1$, and F in C. G. S. lines per linear cm. of poles will be

$$F = \frac{2\pi V}{\log_\varepsilon \frac{R}{r}}$$

It is evident that the scale of the cylinder construction does not enter into the results. We are concerned only with the ratio of the diameters and not with the absolute values of either.

The equipotential surfaces are all concentric cylinders and the surfaces of flow all radial planes. These planes produced inward therefore meet at the axis, which forms the nucleus or polar line of the system. If we take for convenience the external potential of B as zero, and that of A as V, the potential of the axis will be virtually indefinitely great, since such a potential at the axis with zero on the outer circle B, could establish at radius r the potential it actually possesses. Also the distances between successive integral equipotential surfaces will be in geometrical progression. For suppose the resistance per linear centimetre between two particular radii, say $r = 2$, and $R = 3$, to be just unity, then as we need only consider the ratio R/r, which in this case is 1.5, it is evident that the next unit of resistance will be encountered between the radii 3 and 3×1.5 or 4.5, and the next unit again between 4.5 and 6.75, so that the radii corresponding to successive units of resistance, and therefore to successive "drops," or equipotential surfaces, will be 2, 3, 4.5, 6.75, etc., or 2, $2(\frac{3}{2})$, $2(\frac{3}{2})^2$, $2(\frac{3}{2})^3$, etc., and these circles necessarily crowd together and increase in numbers toward the axis, in the neighborhood of which the resistance and potential virtually existing must rise very rapidly. Such a system of potentials is expressed by the well-known equation $v = A + B \log \sigma$ where v is the potential at any point radially distant σ from the axis, A and B constants, so chosen that the actual cylindrical surfaces may possess by this equation their proper values.

Now let (Fig. 5) the inner cylinder A be displaced to a distance h. The cylinders are now eccentric, and the eccentricity may be called $h/R = x$. The cylinder A is still of necessity an equipotential surface, and likewise the cylinder B. There is a strong *d priori* probability that when the first and last members of a series of equipotential surfaces are pure cylinders, all the intermediate members wil be of equally simple type. Such is found to be the case. The equipotential surfaces are a series of eccentric cylinders, and the system has still a nucleus or polar line at P. By symmetry, P must lie on the line of displacement Oh, but its distance from O is still undetermined. Series of cylindrical surfaces in infinite variety can be found, which, starting from some point in Oh, and expanding outwards and sideways, according to a definite law, coincide with the actual surfaces A and B, and give to those surfaces their real potentials; but there can be only one such system which, in doing so, will give rise to no convergence, so as

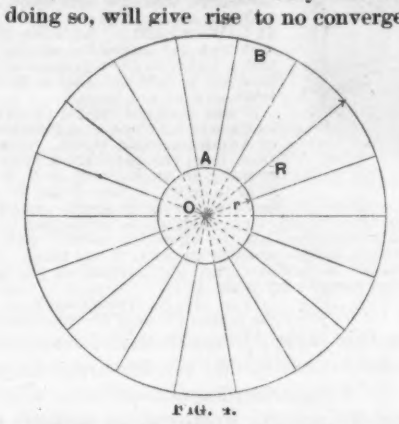


FIG. 4.

to make the flux from any volume element of space exactly equal to that which coincidentally enters it, and it is this property which distinguishes the true system and establishes the distance of the nucleus P. For example: The simplest possible system of expansion would be expressed by $h_\sigma = c\,\sigma$, where h_σ is the distance of the centre of circle of radius σ, measured from the polar line P. On this, as the radius of successive equipotential cylinders uniformly increased, the distance of their centres from the polar line would increase with like uniformity, so that if $r = R/2$, $h = PO/2$. Either geometrical or algebraical test will show that this system cannot fulfill the condition of non-convergence. The true system is expressed by the equation

$$v = A \log_\varepsilon \left\{ \frac{B + \sqrt{4\sigma^2 + B^2}}{2\sigma} \right\} + C.$$

$$h_\sigma = \frac{2\sigma^2}{B + \sqrt{4\sigma^2 + B^2}}$$

where σ is the radius of each successive cylinder, h_σ is the distance of that cylinder's centre from the polar line, while A, B and C are constants that bring the equation into coincidence with any actual case. All the surfaces of flow in this case are segments of cylinders.

For concentric cylinders, then, the flow surfaces are all planes intersecting radially equipotential cylinders. With eccentric cylinders they become cylindric segments orthogonally intersecting cylindrical equipotential surfaces.

To find the resistance S per linear centimetre of eccentric surfaces cylinders, we obtain the formula:

$$S = \frac{\rho}{2\pi} \log_\varepsilon \left(\frac{R}{r} \times \frac{1 + \sqrt{1 + \alpha^2 J}}{1 + \sqrt{1 + J}} \right)$$

where

$$J = \frac{4x^2}{[(1+\alpha)^2 - x^2][(1-\alpha)^2 - x^2]} \text{ and } \alpha = \frac{r}{R}$$

From this formula Table I. has been calculated, giving S to five significant integers for all values of α or r/R from 0.1 to 0.9 inclusive, and all values of x, the eccentricity or h/R from zero to a maximum by steps of 0.1, and the last step, where the change is rapid, of 0.05.

For example, the table shows that the resistance per linear centimetre between two concentric cylinders ($x = 0$) when the outer has twice the diameter of the inner ($\alpha = 0.5$) could be the same (0.11032 ω when $\rho = 1$), as if the outer and inner diameters were in the ratio of 10 to 4 ($\alpha = 0.4$) and the eccentricity also 0.4.

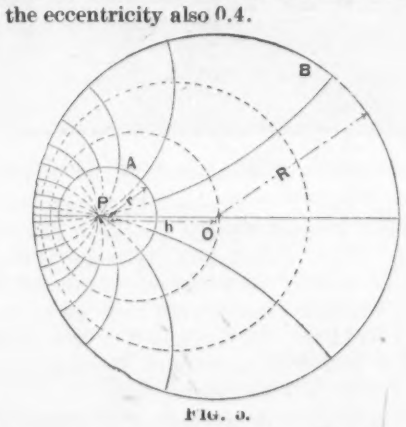


FIG. 5.

Fig. 1 gives the curves plotted from Table I., and with this intermediate values can be obtained by inspection. For example:

A single fluid cell has its elements made up in the form of two cylinders, one outside the other, their radii being 10 and 3 centimetres respectively. The cylinders are immersed to a depth of 15 centimetres and rest on the bottom of the outer cell or jar. If the resistivity of the solution is 25 ohms, what will be the resistance of the cell (1) when the cylinders are concentric, (2) when the inner is displaced from the centre to a distance of 5.5 cms.?

In this case $\frac{r}{R} = \alpha = 0.3$, and in (1) $x = 0$, for which Table I. gives $S = 0.19162$ for resistivity 1. With $\rho = 25$ ω

this will be 4.7905 ω per linear cm., and since the cylinders are 15 cms. long, the total resistance between them will be 0.3194 ω. In (2), $x = 5.5/10 = 0.55$. Examination of the curve in Fig. 1 for $\alpha = 0.3$ gives S at $0.550 = 0.1227$. A direct calculation gives:

$$J = \frac{4 \times 0.55 \times 0.55}{(1.3 \times 1.3 - 0.55 \times 0.55)\,(0.7 \times 0.7 - 0.55 \times 0.55)} = 4.650$$

$$S = \frac{\rho}{2\pi} \log_{\varepsilon}\left(\frac{10}{3} \times \frac{1 + \sqrt{1 + 0.3 \times 0.3 \times 4.65}}{1 + \sqrt{5.65}}\right)$$

$$= \frac{\rho}{2\pi} \times 0.77127$$

$$= \rho \times 0.12275$$

So that the resistance for $\rho = 25$ is 3.0688 ω per linear cm., and 0.2046 ω for the cell.

Table II. gives directly the factor of reduction in resistance due to eccentricity. For instance, in the case just examined the resistance per cm. fell from 0.19162 ω to 0.12275 ω, or in the ratio $\frac{0.12275}{0.19162} = 0.6405$, and Fig. 2, following the curve of $\alpha = 0.3$, we find, in fact, the ratio 0.641. These curves enable eccentric resistances to be found from the geometrical data and the normal concentric resistance. It is curious to observe how little difference often results from eccentricity. Thus, with $\alpha = 0.1$, or cylinder ratios of 10, the eccentricity must be 0.17 to reduce the resistance one per cent., and 0.815 to reduce it by one-half.

Table III. is similarly prepared to yield directly the increase in eccentric conductivity taking concentric conductivity as unity. Its entries are merely the reciprocals of the corresponding values in Table II. It enables fluxes to be determined by inspection. Thus, if the static capacity of a concentric cylindric condenser is φ microfarads, when the diameters are 80 and 10 cms. respectively ($\alpha = 0.125$), a displacement h of 20 cms. will represent an eccentricity of $x = 0.5$. With Table or Fig. 3.

for $\alpha = 0.2$ and $x = 0.5$, 1.2358
" $\alpha = 0.1$ " $x = 0.5$, 1.1454
Difference 0.0904 proportion, 0 0226

Corresponding value by interpolation for 0.125, 1.1680

The capacity is therefore reckoned to be 1.168 φ.

The value calculated by Gaugain for this case in 1862 was 1.169.

Table and Fig. 1 are therefore suited to the determination of eccentric resistances.

Table and Fig. 2 are available for converting concentric into eccentric resistances.

Table and Fig. 3 are suitable for determining eccentric from concentric fluxes.

TA BLE NO. I.

Resistance between cylinders per centimetre of their length, with material of unit resistivity. Column I. contains nine values of α or r/R Column II. the corresponding resistance for concentric cylinders. The other columns refer to increasing eccentricity.

I. α	II. 0	III. 0.1	IV. 0.2	V. 0.3	VI. 0.4	VII. 0.5	VIII. 0.6	IX. 0.7	X. 0.8
0.1	0.36617	0.36484	0.35990	0.35121	0 33835	0.31996	0.29397	0.25616	0.19510
0.2	0 25615	0.25448	0 24936	0.24041	0.22686	0.20728	0.17876	0.13386	0.09784@0.75
0.3	0.19162	0.18986	0.18443	0.17485	0.16009	0.13798	0.10996	0.07484@0.65	(0.14312@0.85)
0.4	0.14583	0.11392	0.13799	0 12734	0.11032	0 08253	0.05862@0.55		
0.5	0.11032	0.10817	0.10419	0.08887	0.06703	0.04886@0.45			
0.6	0.081113	0.078772	0.070557	0.054099	0.039777@0.35				
0.7	0.056766	0.053551	0.042411	0.031495@0.25					
0.8	0.035514	0.030773	0.023516@0.15						
0.9	0.016769	0.014425@0.05							

The last entry in each row or column refers to an intermediate eccentricity (increased by 0.05). Eccentricity $= x = h/R$

TABLE NO. II.

Resistances included between parallel cylinders with various degrees of eccentricity referred to those with concentricity as unity.

I. α	II. 0.0	III. 0.1	IV. 0.2	V. 0.3	VI. 0.04	VII. 0.5	VIII. 0.6	IX. 0.7	X. 0.8	XI. 0.85
0.1	1.0	0.99557	0.98208	0.95838	0.92329	0.87308	0.80217	0.69899	0.53238	0.39273@0.85
0.2	1.0	0.99349	0.97349	0.93855	0.88564	0 80920	0.69788	0.52257	0.38197@0.75	
0.3	1.0	0.99080	0.96249	0.91249	0.83544	0.72010	0.53733	0.39139@0.65		
0.4	1.0	0.98890	0.94620	0.87318	0.75617	0 56591	0.40198@0.55			
0.5	1.0	0.98051	0.91934	0.80560	0.60758	0.44291@0.45				
0.6	1.0	0.97114	0.86986	0.66696	0.49040@0.35					
0 7	1.0	0.94352	0.74712	0.55482@0.25						
0.8	1.0	0.86649	0.66216@0.15							
0.9	1.0	0.86021@0.05								

TABLE NO. III.

Flux between parallel cylinders maintained at a fixed difference of potential with varying eccentricity. The flux with concentric cylinders being unity.

I. α	II. 0	III. 0.1	IV. 0.2	V. 0.3	VI. 0.4	VII. 0.5	VIII. 0.6	IX. 0.7	X. 0.8
0.1	1.0	1.00445	1 01824	1 04343	1.08758	1.14537	1.24263	1.43063	1.87834
0.2	1.0	1.00655	1.02723	1.06547	1.12913	1.23579	1.43288	1.91361	2.61805@0.7
0.3	1.0	1.00929	1.03898	1.09590	1.19699	1.38870	1.86106	2.56091@0.65	(2.54026@0.85)
0.4	1.0	1.01327	1.05682	1.14551	1.32193	1.76705	2.4887@0.55		
0.5	1.0	1.01984	1.08773	1.24132	1.64589	2.25 78@0.45			
0.6	1.0	1 02972	1.14965	1.40934	2.03917@0.35				
0.7	1.0	1.0597	1.33848	1.8024@0.25					
0.8	1 0	1 15408	1.51022@0.15						
0.9	1.0	1.13251@0.05							

The last entry in each row or column refers to an intermediate eccentricity (increased by 0.5). Eccentricity $= x = h/R$

Some of the Uses of the Search Lights.—II.*

BY R. H. BACON.

The case just mentioned is the usual one on board ship, especially when the object is traveling toward the ship at a high rate of speed. The practical proof of this is shown by the fact that a boat is rarely itself recognized in the first instance at any great distance, but originally attention is attracted to her by her bow wave—that is, the wave of foam, which reflects a comparatively large amount of light, and shows up distinctively against the surrounding dark-colored water.

Were the above case, viz., that of detecting boats from a ship by means of a search light in the ship, the sole use of that weapon, it might, indeed, be an open question whether the electrical beam is of any material good in naval warfare for there is one point which never must be forgotten, and that is, that the fact of burning such a light reveals the position of the ship to an attacking boat, when, by an absence of all lights, the darkness of the night might be a more efficient protection. It is this particular case which is the one that correspondents in manœuvres are most frequently brought into contact with, and on it opinion is so much divided that in open water it is probable that no captain would promiscuously use his search light as a method of defence. However, other occasions arise in war time when the search light is of great value. These may be divided roughly under two heads—(1) Defense of a fleet in close waters, where the position of the anchorage water of itself reveals the probable position of the fleet; and (2 Fleet action at night, or action between single ships.

Regarding (1) the case may be briefly stated as follows: Ships are at anchor in a close anchorage for some particular reason, either for repairing or refitting purposes, or else the close presence of a superior force. For it is inconceivable, considering the deadly nature of a torpedo boat attack, that an officer would keep his fleet at anchor at night in a harbor that afforded by its position a possibility of an attack from torpedo boats if he could possibly avoid it. Supposing such the case, the search light may be a most efficient help against such an attack. Light may be burned at a distance from the ship on shore to light up the entrance or different sections of the passages through which the torpedo boats will have to pass, or the ships may illuminate the passages and use observers in their guard boats. In either case the effect is the same, for no longer has the light reflected from the attacking boats to be reflected at a small angle to the observer, but the observer is placed in a far better position as regards reflection, and far more minute differences in shape can be observed, since the reflected light is much greater. In other words, a greater contrast is produced between non-reflecting bodies and the water. Gun fire can, therefore, be more effectively used, and greater havoc effected on the attacking force. In such a case, one thing is certain, for detecting boats all beams must be fixed so that observers may get their eyes accustomed to a constant intensity of light, and not a variable one, as produced by "sweeping" beams. This is the most effective use of an electric search light. A few beams may, of course, be kept in reserve for following up and illuminating boats after they have been detected, but these should be quite independent of the fixed beams. The guard boats, some 2,000 yards away, can see the approach of others several hundred yards off, since the surrounding water is well illuminated by the beams of light playing on it. When the boats are discovered, it is necessary to light them up sufficiently for the guns' crews in the ships or boats to use their guns. This may be done by the ships' projectors with divergent lenses in conjunction with parallel beams, the divergent lenses being used to light the boats up, and from their large divergence prevent the chance of losing sight of them again, and the parallel beams to more brightly illuminate them and make them more clear to the guns' crews.

Again, in single ship or fleet action at night, search lights must be used to light up the enemy, and now the search light is no longer an objection, as showing the position of the ship, since its height prevents an accurate estimation of the position of the water line (the most vulnerable position in the ship to fire at), but in reality it is absolutely a safeguard, both since it is misleading as to the distance of the ship and also is blinding to the opposing guns' crews. From the foregoing remarks it will be seen that the function of the search light may be either to discover or to light up an object for guns to fire at. These two different uses are important, since they lead to the height of the light being varied to some considerable extent. It has long been the opinion that for discovering boats the beam should be below, since its direction is parallel to the surface of the water, and therefore, lights up a larger area than would be the case if thrown down on the water from a height, when the plane of the water would cut the beam in an ellipse whose area depends on the inclination of the beam. But a little thought will show that if the beam be parallel to the water the water is but feebly illuminated, whereas a body, vertical to the water, cuts the beam at right angles and receives a large amount of light. Were the body absolutely non-reflecting, it would be invisible; but if reflecting, a contrast will be obtained. Now that boats can be painted so as to be practically non-reflecting, the low beam is viewed with more disfavor, especially as detection is not the chief function of a light on a ship. The real function of the light on board is to light up an object whose approach has been detected, so that the guns' crews can accurately lay their guns. To do this it is necessary to keep the light as far from the guns as possible, and also to keep the beam off the water near the ship, so as to prevent the men being dazzled. The best position in the case would appear to be to have the light above the guns, so that the crews practically do not see the beam, except where it strikes the object, and also should the opposing ship use the light to aim at the shot will be more likely to pass over the ship. Another great point is to have the projectors so placed as not to illuminate any portion of the side or superstructure of the ship; this, again, is best obtained by a fairly high position of the light.

For attacking forts or in action in moderately smooth water a light in the military tops would seem to answer these requirements; but, of course, with even a moderate motion of the ship a beam from a projector so placed would sweep through a far larger arc than one in a lower position, and would, therefore, be far harder to keep steadily illuminating an object. For navigating purposes, where the water for some distance ahead of the ship has to be illuminated, a low position of the light is best.

For signaling purposes at night a beam may be thrown on a cloud, and its reflected light will be seen at considerable distance; the distance, however, depends on the height and position of the cloud, and a general rule as to visibility cannot, therefore, be even approximately laid down.

In this short article many points have been intentionally omitted. The position of observers has no interest except to those technically connected with the service. Automatic lamps and projectors, though of great importance, are beyond the scope of the present outline, which is only intended to point out a few of the many difficulties and problems that arise in the practical use of the search light. So much criticism on the lights has been passed in late manœuvres that it is only fair to point out that isolated uses of the light in manœuvres (and those generally in one particular, and that the most inefficient occasion, viz., the detection of boats) are not the sole uses, and that, therefore, it is unfair to judge of the importance of the light to the navy by them. Our material is excellent, thanks to themakers—we cannot say the best, since the best is never arrived at, and all things improve day by day—but the failure of the light to do all that we wish is rather our own fault for expecting it to fulfill the condition of daylight, when after all our 5,000 watts can but give us a definite amount of light which in its turn has to obey the inexorable laws of optics.

*From *The Electrician* (London).

The Ammonia Motor System.

A new system of street car propulsion some time ago appeared in the field, which was claimed by its inventor, Mr. P. J. McMahon, to be a formidable rival of the electric car, as well as the cable and horse car. The advantages claimed for it in the matter of safety, efficiency and economy are such as to excite interest and entitle it to careful examination.

The principle on which this invention is based is the use of ammonia gas in the place of steam for operating the piston of an engine placed beneath an ordinary street car The cylindrical reservoir from which the gas is supplied to the engine or tank surrounding the reservoir for the reception and absorption of the exhaust gas after it has done its work on the piston are also placed beneath floor of the car.

Three gallons of anhydrous ammonia will give off sufficient gas, it is claimed, to run a 16-foot car one mile on average grades and roads, exerting a pressure of 150 pounds per square inch on the piston of an ordinary engine at a temperature of 80 degrees Fahrenheit, which is the temperature at which the weak solution surrounding the anhydrous ammonia reservoir was charged into the tank.

It is claimed that a 16-foot car can carry a sufficient charge to run at least 25 miles.

The cost of preparing the anhydrous ammonia as used at the station is claimed to be less than one cent per car mile, and as there is no loss in distributing the power over the route, as in either the cable or the trolley system, it is therefore claimed that this system can be operated much cheaper than either of the latter. Careful tests have been made both in this country and England with very satisfactory results.

The Determination of the Self Induction of a Coil from Its Dimensions.*

BY EDWIN PLACE.

Two important constants belonging to a coil of insulated wire are those known as the galvanometer constant G and the coefficient of self induction L, sometimes called the inductance. The former is a number which expresses the strength of magnetic field at the centre parallel to the axis for unit strength of current in the coil. The self induction is the number expressing the sum of all the lines of force which are inclosed by the separate turns of wire due to unit current through the coil.

Since G is the strength of the field at the centre due to the combined action of all the turns of the coil, its value can be found by calculating the strength of field there for each turn and taking the sum. By reason of the symmetrical position of the centre with respect to the various turns of a uniformly wound coil, the calculation of G is in most cases comparatively simple. It is obvious, however, that the calculation of L from the dimensions of the coil is generally not an easy matter. For the number of lines of force piercing the area bounded by any turn is made up of those due to its own current and the current in the remaining turns of the coil; the turn lying next to this would be pierced by a slightly different number, and so on for the rest. The summation for all the turns would then give L. Its calculation after this manner would necessitate the use of an algebraic expression each of whose terms is quite complex and would make the numerical work somewhat tedious.

The value of L can be arrived at in a much more simple manner in the case of a coil whose length and radial depth of winding are each small compared to the radius. The magnetic force at the centre parallel to the axis for unit current is, for such a coil,

$$G = \frac{2\pi n}{R_m}$$

approximately, where n is the number of turns of wire and R_m the mean radius of the turns. This is the smallest value of the field in the plane bound by the coil and hence the average force over that area is somewhat greater than G. If F_m be the value of this mean force, we write]

$$\frac{F_m}{G} = K \text{ or, } F_m = G\,K$$

where K is an abstract number.

Multiplying this equation by the area of all the turns or n times the area of the mean turn gives

$$L = F_m\, n\, \pi\, R_m^2 = 2\,\pi^2 n^2\, K\, R_m$$

approximately.

The right member of this equation shows that L is proportioned to n^2 and to K times the radius. The factor K depends on the shape of the circuit and the law of magnetic force near a conductor and can be calculated from the dimensions of the circuit. And since it is an abstract number, the product $K\,R_m$ is the length of a line. Hence L is expressed by a length, and if the dimensions are measured in centimetres L will be in centimetres. Coils surrounding masses of iron possess such large inductances that the number expressing them would be inconveniently large. So a unit has been chosen which is 10^9 as large as the centimetre unit and called the "henry" or "quadrant." Which is equivalent to saying that if the dimensions of a coil are measured with a unit as long as the earth's quadrant L would be given in "henrys" or quadrants, since the earth's quadrant is 10^9 centimeters in length.

Maxwell has given a method for calculating L for a more general case which is easier to use and more exact than any other. He has shown the self induction of a circular coil free from magnetic material to be numerically equal to n^2 times the mutual induction of two parallel coils of radii equal to the mean radius of the given coil, each consisting of one turn placed with their axes in the same line and separated from each other a distance D_g; this distance being the "mean geometric distance" of the cross section of the wire space; n being the number of turns in the given coil.

The mean geometric distance D_g of an area is defined thus: If the area be divided into small equal elements and the area of one be multiplied by the nap. log. of its distance from another element; then if the sum of all such products be taken for every pair of elements, it will be equal to the whole area into the nap. log. of the distance designated by D_g above.

For a rectangle of sides a and b, it is expressed by the equation,

$$\log_e D_g = \log_e \sqrt{a^2 + b^2} \; f.\left(\frac{a}{b}\right) \qquad (1)$$

Having found D_g from this, the mutual induction M for the two imaginary circles can be calculated from the equation

$$\frac{M_1}{4\,\pi\, R_m} = \frac{1}{\sin\, a}\left[2\,E - (1 + \cos^2 a)\; F\right] \qquad (2)$$

in which R_m is the mean radius of the given coil and a is an angle described as follows: Consider the two equal circles of radii R_m, and let A be a diameter of one circle and C the diameter of the other which lies in the same plane as A. a is the angle subtended by C as seen from either extremity of A.

The right member of equation (2) is a function of a alone. In vol. ii. of Mascart and Joubert, "Elect. and Mag." is given a table showing the numerical values of that function for value of a from 60 degrees to 90 degrees. Having found from this equation M_1 multiplying it by n_2 we have

$$L = n_2\, M_1.$$

Some time ago the writer made use of these equations in calculating the self induction of a large solenoid which was to be built for an investigation of the physiological effect of a varying magnetic field on the human body. This coil was specified to be 18 inches internal diameter and 60 inches long, dimensions large enough to comfortably inclose an ordinary person. An alternating current of a frequency of 50 per second was to be sent through the coil after the person had been put inside, and the result carefully watched from a safe distance by the reporters and investigating committee. Whether the alternating field passing through the body of the victim would, in such an overwhelming presence, succeed in bracing him up or produce the dire result of scaring him to death can only be conjectured. The coil has lately been built but no report has been made on its performance to the writer's knowledge.

In addition to the above data it was specified that the current density per square inch of section of wire space should be 1,200 ampères when an alternating E. M. F. of 300 volts was applied to the terminals. It was required to find the size of copper wire to be used and the depth of winding; also of the strength of maximum field at the middle of the coil and the power required for 50 ampères in the wire.

The problem as stated would be quite easily solved if instead of the alternating E. M. F. a steady one of the same voltage were used.

But on account of the inductance of such a coil the resulting current would differ from that calculated from Ohm's law simply. The first step taken in the work was the determination of the resistance, size, number of turns, etc., of the wire to satisfy the conditions of current density and terminal volts when wound to different depths, on the assumption that the E. M. F. was a steady one. From equations (1) and (2) above, the corresponding values of L were calculated in "henrys." The following table shows the values of the several quantities for different values of the depth of winding:

Depth in inches. h	Diameter of wire in inches. D	Resistance. R	Number of Turns of Wire. n	Self Induction in "henrys." L
½	.078	40.9	4900	4.09
1	.112	19.9	4780	4.00
2	.162	9.48	4550	3.86
3	.204	6.0	4338	3.7
4	.241	4.3	4146	3.6
5	.275	3.3	3970	3.5
6	.308	2.6	3807	3.4

The current obtained when an alternating E. M. F. is applied to the terminals of a coil is

$$C = \frac{E}{\sqrt{R^2 + L^2 p^2}}$$

where E is the E. M. F., R the resistance, L the inductance and p the periodicity, in which $p = 2\,\pi$ times the number of alternations per second.

This equation may be written

$$C = \frac{E}{R}\,\frac{1}{\sqrt{1 + \left(\frac{L\,p}{R}\right)^2}} = C_1 \quad \frac{1}{\sqrt{1 + \left(\frac{L\,p}{R}\right)^2}}$$

in which C_1 is the current strength for a steady E. M. F., or for an alternating E. M. F. acting on an equivalent resistance having no inductance. For our present case, we may treat it according to the latter supposition and call it the non-induction current. The relation between E. M. F., resistance and current in a non-inductive circuit is defined by Ohm's law whether the E. M. F. is alternating or steady. Hence assuming the inductance zero in the coil C_1 would have the same value as that calculated from the values of R in the table above for any value of h chosen.

This equation shows that the actual current C is always less than C_1, when self induction is present in the circuit, and therefore the current density is less. The effect of the inductance can be counteracted by diminishing the resistance of the coil a proper amount. The table shows that by winding to a depth of three inches so as to make the resistance 6 ohms, the current would be 50 ampères if L were zero. By winding to the same depth with a larger wire the resistance can be made as small as required, but the ratio $\frac{L}{R}$ will not be changed thereby. Hence if r is the required resistance its value will be determined by the equation.

$$\frac{r}{R} = \frac{1}{\sqrt{1 + \left(\frac{L\,p}{R}\right)^2}} \text{ in which}$$

$$R = 6,\; L = 3.7,\; p = 2\pi n = 314.$$

Making these substitutions, we have

$$R = .0312 \text{ ohms.}$$

Since for coils of the same size the resistances are inversely as the fourth power of the diameters we have, if d is its diameter,

$$\left(\frac{d}{D}\right)^4 = \frac{R}{r} \text{ or } d = D\left(\frac{1}{.0312}\right)^{\frac{1}{4}}$$

in which $D = .204$.

Hence $d = .76$ inches.

This is the diameter of the conductor wound to a depth of 3 inches that would give a current of 50 ampères. But it is quite obvious that the current density corresponding to it is far below 1,200 per square inch of channel section, in fact only about 87 ampères. The accurate determination of size of wire, depth of winding to give a certain current density with a given alternating E. M. F., is really of no practical importance, in the present case, and fortunately so. For, the solution of such a problem would be next to an impossibility by analytical methods, owing to the difficulty of expressing one dimension as an explicit function of L and the other dimension. Evidently the density can be made any value desired by simply changing the E. M. F. at the terminals in proportion to the current density desired; in the present case it would have to be increased in the ratio of $\frac{50}{(.76)^2}$ or about 14 fold, thus making 4,200 volts, nearly.

It is unnecessary to give the results of the further calculations made on the coil, the purpose of this discussion being to describe the method used in calculating its inductive co-efficient and to show how one of its effects on an alternating current is neutralized.

* The Rose Technic.

Electrical Progress in Germany.

(From Our Special Correspondent.)

The report of the *Berliner Elektricitatswerke* for the year ending June 30 last gives the following particulars: The number of subscribers has increased during the last year from 1314 to 1782, or 35 per cent., and the total number of lamps installed, or their current equivalent, from 104,100 to 136,600, viz., 31 per cent.; and lastly the total consumption of energy from 71,620,371 to 85,175,900 normal lamp hours, or 19 per cent. At the same time the gross receipts for current supplied, lamp tax and rent on meters have grown from approximately $646,800 to $781,820. The number of motors run from the mains of the works is 121, representing about 500 h. p. The net profit stands at $217,150. Of this amount $10,850 is to be placed against the reserve fund required by law, and the balance distributed in the 7¼ per cent. dividend declared. The share in the profit accruing to the city amounts to $12,810.

According to the Prussian Statistical Bureau the total number of steam engines employed in the production of electric energy in Prussia has increased during the last two years 28 per cent., and the capacity of the same 39 per cent. While at the beginning of 1891 these engines represented 1.59 per cent. of the number and 2.68 of the capacity of all stationary and movable steam engines in Prussia, these figures had risen at the beginning of the current year to 1.94 per cent. and 3.5 per cent respectively.

The scheme which was proposed a little while ago by the Allgemeine Elektricitäts Gesellschaft for an underground electric railway for Berlin has taken further development. The peculiar formation of the local subsoil would, it seems, call for specially adapted apparatus, and this apparatus has been the subject of various patent applications on the part of the Allgemeine company. The patents have now been granted, and a model of the plant is on view at the company's show rooms in Berlin. This model is to be exhibited at the World's Fair.

Plans for the electric lighting of the Lustgarten in Berlin—opposite the Imperial Palace and the Old Museum, one of the most imposing parts of the German capital—have been submitted to the City Council for approval, in order to obtain the required funds, which amount to $5,095. The electric light is also to be introduced into the museums in Berlin very shortly. This will certainly be greeted with satisfaction by many whose ordinary every-day occupations prevent them from visiting these institutions during the daytime. It is somewat remarkable that nothing has been done in this direction before in Berlin, where electric lighting has advanced so much further than it has in many other large cities in Europe.

Messrs. Siemens & Halske's project of an elevated electric railway connecting the central part of Berlin with the west end has been approved by the local authorities, and has now been referred to the Ministry of Railways; finally it will have to obtain the Emperor's sanction. The scheme has been approved substantially as submitted, the only modifications made having reference to the route the line should follow. It is not proposed to employ electric locomotives, as on the London underground electric railway. Messrs. Siemens & Halske do not consider electric locomotives suitable or desirable, as their only advantage over steam locomotives consists in their being smokeless, while all the other advantages of electric traction are lost. They intend to use motor cars, each car being equipped with two electric motors.

Several technical advantages are claimed for the use of motor cars, and it is urged that a train made up of motor cars is better able to round curves and climb steep grades, though it is not quite clear where the steep grades will come in in this case. Probably one of the most important advantages, however, with motor cars will be in connection with the construction of the viaducts, which will then be required to carry a weight of one to one and a half tons, whereas if locomotives were employed, the weight to be carried would amount to something like seven tons. There are to be 10 stations on the line, including the termini at either end. The stations are to be arranged as simply as possible, consisting of no more than platforms directly accessible by steps from the street, and covered with a lightly constructed roof extending over both lines of rails from platform to platform. Where the local conditions permit, the stations will be provided with separate approach and exit steps

at each end of the platforms. The permanent way of the viaducts is to be constructed with a wire netting stretched between the girder work and covered with cement or similar material. This will, it is said, make not only a thoroughly firm roof overhead, but will also tend to do away with the noise of passing trains. Particular pains will be taken to introduce into the construction of the viaducts as much of the artistic element as possible, both as regards their embellishment in detail and the appearance as a whole, so that the line may be ornamental as well as useful. The scheme is not regarded with favor, however, by everybody, and an association of house and land owners in the west end of Berlin has protested vigorously against its being carried out. Their protests are based on the argument that some of the finest streets in the west end will thereby be entirely spoiled, the inhabitants deprived of light and air, and the value of the neighboring property seriously affected. And these arguments are not unreasonable, because an elevated railroad, electric or otherwise, will not enhance the beauty of a fine, broad street like the Bülow Strasse, through which, among others, the proposed line is to run. Whether the project will become un fait accompli remains to be seen.

The Electrotechnischer Verein held its first meeting after the summer vacation on the 25th of October. The president introduced the business of the meeting with a retrospect on the progress of electrical work during the current year. In general, things had been quieter than last year, when the Frankfort Exhibition naturally taxed all the electrical and allied industries to the utmost. Some figures, based on data issued by the Administration of the Imperial Post and Telegraphs, were given relative to electrical installations in Germany, according to which there were on July 1 last in Germany (excluding, however, the States of Bavaria and Wurtemberg) 4,272 electric light installations with 733,025 incandescent and 39,945 arc lamps; besides these there were 20 installations for electrolytic purposes and 53 power transmission plants. There were 68,193 miles of telegraph lines belonging to the government, with 200,316 miles of telegraph wires and 18,573 telegraph offices; 324 cities had general telephone systems with 68,000 telephone offices. Berlin still took the lead, as it had done for some years, of all the cities in the world, with 18,100 telephone subscribers. The inter-urban telephone system provided communication between 340 points, with a total length of 15,537 miles of line. The president in concluding his address expressed the hope that the electricity laws, which were now in their inception, would create as few difficulties as the recent promulgated telegraph laws had done. Following these remarks Dr. Du Bois read a paper descriptive of a magnetic balance. The apparatus shown and described at the meeting serves to determine numerically, with rapidity and certainty, the magnetic properties of wrought iron, cast iron and steel used on electrical work. A paper was then read on the dangers and detrimental effects of bare circuits carrying heavy currents. The paper became the subject of a lively discussion, the continuation of which, however, had, owing to lack of time, to be postponed to the next meeting, taking place on the 22d of November.

Messrs. Siemens & Halske are in negotiation with the local authorities of Lichterfelde, near Berlin, regarding the removal and possible extension of their old electric road there.

The Society of German Engineers has voted the sum of $7,140 towards the cost of suitably representing German engineers at the Chicago Exposition.

The Allgemeine Electricitäts Gesellschaft has just opened an electric tramway in Trotha, connecting that place with Halle, where, it will be remembered, it has an electric line already. The same company has applied for a concession for the construction of an electric tramway in Dessau.

There are a considerable number of electrically operated mining plants in Saxony, the most extensive and most interesting at present being probably that of the Carl G. Falck Colliery at Bockwa, near Zwickau. The primary station consists of one 50-h. p. dynamo developing current at a working pressure of 500 volts; this machine is driven by a 65-h. p. steam engine, which drives at the same time a dynamo for lighting purposes. The current generated at the primary station is, after passing through the necessary measuring, controlling and safety apparatus, conveyed by a well insulated cable to the different secondary stations. The first motor is located in the pit-eye of the nut coal vein, at a depth of 621 feet, and is coupled directly to a centrifugal pump raising 440 gallons of water per minute to a height of 58 feet. Special room has been provided for the second and third motors at a depth of 762 feet. These drive by means of belting two duplex pumps, each raising 130 gallons of water to a height of 195 feet per minute. The fourth motor serves to drive a small mining locomotive of 4. h. p. This has replaced the former horse traffic in the main crosscut over a length of 325 yards, and is capable of hauling 10 fully loaded coal trucks at the rate of 96 yards per minute. The pumping plant has been in operation since the beginning of the year and the locomotive somewhat over a month. Everything has given entire satisfaction. The work was carried out by Messrs. Schuckert & Co., which firm has also installed a number of similar plants in different parts of Germany. The Union Elektricitäts Gesellschaft, of Berlin, has signed a contract for the electric equipment on the Thomson-Houston system of the lines of the Société Nationale des Chemins de fer Vicinaux in Brussels.

BERLIN, Oct. 31, 1892.

Experimental Studies of the Differences of Potential Generated Through Contact of Metals, Liquids and Dry Electrolytes.—I.*

BY WALTER NEGBAUR, PH. D.

The modern views of the causes of the differences of potential at the poles of galvanic cells are based, no matter how much they differ in regard to their premises, upon the fact that the E. M. F. at the poles of a cell is equal to the algebraic sum of all the separate E. M. Fs. at the surfaces of contact of the different portions of the conductor.

The determination of the E. M. Fs. for testing one or the other of the theories built up in accordance with this assumption has been undertaken, up to now, only with cells with dissolved electrolytes, in which the primary causes of the generation of current are usually accompanied by secondary actions which on the one hand give rise to new differences of potential, and on the other hand may destroy the original source of current.

But by limiting the investigation to the certain special case of very dilute solutions, fluid cells can be constructed in which only the primary processes appear.

Likewise when we go to the other extreme to batteries with solid dry electrolytes, we find regularities that lead us to think that in this case also we have no secondary processes. I have therefore made the experimental work just at these two limits and have compared the results with those calculated theoretically.

A.—DIFFERENCES OF POTENTIAL AT THE SURFACES OF CONTACT OF VERY DILUTE SOLUTIONS.

The investigation of the question regarding the differences of potential between solutions of salts, was begun by von Helmholtz†. The theory proposed by him permits of calculating the differences of potential of those cells which are composed of two different concentrated solutions of the same salt, and in which the electrodes consist of the metal of this salt. The difference of potential of such a concentration cell, is made up of three components, of which two appear at the electrodes and the third at the point of contact of the solutions. The magnitude of the latter, which chiefly interests us here, cannot be obtained separately from the others from the formula.

More recently, W. Nernst‡ has succeeded in simplifying the theory of the concentration cells, by confining his observations to very dilute solutions, and by the introduction of the osmotic pressure. By the use of reversible electrodes, he has made an experimental confirmation possible. The formulae that he developed proved on the one hand to be identical with that of von Helmholtz, but on the other hand permitted a decomposition of the sum of the three differences of potential into the sum of the two appearing at the electrodes, and that between the fluids themselves.

Later, M. Planck§ working on the same fundamental principles of Nernst, arrived at the same result, and then extended the theory for the general case of two differently concentrated solutions of chemically different binary electrolytes, but without considering the differences of potential due to the introduction of the electrodes.

If this theory is applied in the special case of a concentration cell, it gives again the formula first proposed by Nernst for the component between the two solutions. Both theories search for the cause of the differences of potential exclusively in the motion of the ions, but as they are based upon the dissociation hypothesis they hold good only for very dilute solutions. Von Helmholtz' formulae are applicable to all concentrations.

The experimental confirmation of the general case mathematically treated by Planck, has not, up to the present time, been given.

The differences of potential between two differently concentrated chemically different solutions (under the condition that all the ions have equal valency, in our case the valency one) is, according to Planck, given by the formula:

$$\varphi_2 - \varphi_1 = \frac{R}{\varepsilon} \cdot \lg. \xi,$$

in which R is the osmotic pressure, ε denotes the electric charge of one univalent positive ion (therefore a constant) and ξ is derived from the equation:

$$\frac{\xi U_2 - U_1}{V_2 - \xi V_1} = \frac{\lg \frac{c_2}{c_1} - \lg \xi}{\lg \frac{c_2}{c_1} + \lg \xi} \cdot \frac{\xi c_2 - c_1}{c_2 - \xi c_1}$$

In this c_2 and c_1 are the concentrations of the solutions in contact. $U_2 = u_2 c_2$; $U_1 = u_1 c_1$; and here u_2, u_1 are the velocities of the positive ions. $V_2 = v_2 c_2$; $V_1 = v_1 c_1$; and here v_2, v_1 are the velocities of the negative ions.‖

To obtain the differences of potential between fluids, we can either:

(a) Use many-membered cells with identical end members, or

(b) We can place in the two solutions metal electrodes of which the electromotive effect with the fluid is known. Planck's theory gives no assistance to the calculation of the differences of potential at the electrodes. We would be therefore constrained to use combinations of the first kind, but the second arrangement may be verified by application of mercury electrodes, depolarized with calomel as used by Nernst.

The cells of the first kind have the disadvantage that relatively great E. M. Fs. appear only with the use of very differently concentrated solutions. Besides, in this arrangement we always measure the sum of at least three differences of potential. If among the solutions there are any whose salts have equal anions or kathions, these obey moreover the law of the electro chemical series (completely, however, only with equal total concentration), and contribute therefore not at all or only a little to the E. M. F. of the cell.

The two membered cells with metal electrodes are

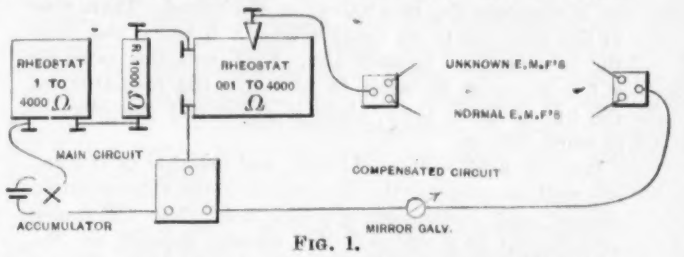


FIG. 1.

more inconstant; even metals which can be obtained of great purity, as silver, show, in their electromotive behavior, especially in very dilute solutions, fluctuations, whose causes have, heretofore, been only partially investigated.

A compensation method was used for the measurement of the differences of potential. The arrangement is shown in the accompanying sketch (Fig. 1).

An accumulator served for compensation. A large rheostat of from .01 to 4,000 Ω formed the common part of the two circuits. In the main circuit 20,000 Ω were permanently inserted, besides a second rheostat, which allowed the total resistance of the main circuit to be kept constant. The absence of current in the compensated circuit was detected by a sensitive Wiedemann mirror galvanometer. The unknown E. M. Fs. which were compared with that of a Latimer Clark normal element are in this arrangement in proportion to the resistance in the common part of the circuits. I gave the following form to the normal element (compare Fig. 2). Total height is 6 cms. The mercury is placed in the two armed tube a, b, the platinum wire is led without insulation into the shorter arm a, and the paste is introduced into the longer arm b. The little auxiliary cylindrical tube c contains the rod of zinc. The opening between the two little tubes b and c must be as large as possible. Closing this opening with parchment has been shown to be superfluous. The generation of crystals and their growing up on the glass may be prevented by a layer of vaseline oil or by hermetically closing the tubes b and c. It is a good

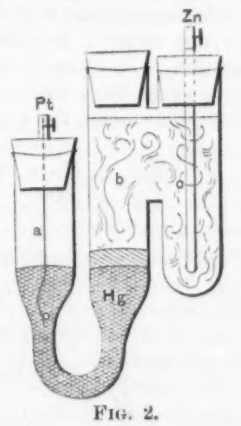


FIG. 2.

plan to protect the element from light by covering it with black paper, and it is also preferable to place it in a little paraffine case. The normal element has a greater internal resistance in the new than in the old form, but possesses the advantages that the porous cup is avoided, the use of mercury is mimimized, and the individual parts of the cell are easily accessible.

For the measurement of very small E. M. Fs. I used calomel concentration cells for comparison. These cells, which consist of two differently concentrated solutions, of one and the same salt or an acid between mercury depolarized with calomel, have the great advantage that the substance of which they are composed can be obtained in a condition of great purity. By the alteration of the relative concentration, any desired difference of potential may be obtained. This can be previously calculated. The cells are, therefore, particularly fitted for normal elements. I have, with this in view, subjected the constancy of the E. M. F. to a thorough experimental test with good results, and have given the glass apparatus the form shown in Fig. 3, and now to be described. The well fitted glass cock G separates the two differently concentrated solutions from each other. A plug of parchment paper is driven into the bore of the glass cock. The part of the vessel to the right of the glass cock serves for the reception of the more concentrated solution. The two little glass tubes, a and d, contain mercury with a layer of calomel poured over it. The platinum

* Based upon papers published in "Wiedmann's Annalen," 1891 and 1892.
† H. v. Helmholtz, Berl. Ber. 26 Nov. 1877.
‡ W. Nernst, Zeitschr. f. phys. Chem. 4, p. 129. 1889.
§ M. Planck, Wied. Ann. 39, p. 161, 1890; and Wied. Ann. 40, p. 561, 1890.
‖ For the solution of this formula and the necessary corrections, see Wied. Ann. 44, p. 748, 1891.

wires (Pt,Pt), fused in the glass, make connection from the mercury to brass terminals furnished with binding screws. As it is only essential to maintain the original concentration at the electrodes, the little glass tubes b and c are interposed to prevent the mingling of the two solutions. It is convenient to place thermometers in these tubes.

The element may be set up in the following manner. First we should mix in two watch crystals the calomel with the solution with which it is in contact in the element, until no more bubbles rise from the mixture. Then pour absolutely pure mercury into a and d so that the platinum conductors are covered, then fill the glass tubes a and d half way up with the above mentioned concentrations and put the paste in the solution with a glass spoon; it releases itself from the spoon and spreads itself evenly over the mercury. The glass cock, whose plug should be previously soaked in the more concentrated solution, should be wiped, and then inserted so as to separate the two halves of the vessel. Then pour in the solutions to an equal height in b and c and close the tubes a b c d hermetically. Now open the cocks for a few minutes, in order to facilitate the formation of the intermediate layer, close it again and the element is ready for use.

Muriatic acid, sodium chloride, and chloride of lithium, are well adapted for the generation of the concentration current, and particularly muriatic acid. The differences of potential of a concentration current depend on the magnitude of the difference of velocity of the participating ions. Since the H ion moves much more rapidly than any of the others, we can with the muriatic acid cell generate relatively great potentials with small differences of concentration. The muriatic acid cell gives, for example, with a concentration ratio of about 1 : 10, 1 volt, while the NaCl cell, under the same conditions, gives only about 0.04 volt. In order to generate 0.1 volt, we can use solutions which contain 4.0 HCl, against 0.99 HCl, or 2.5 NaCl, against 0.1 NaCl per litre, therefore the concentration ratios 4 and 25. A small difference of concentration is of advantage for the constancy of the element, since the diffusion increases with the difference of concentration and the concentrations tend to become equal, and, therefore, make the element useless. So, theoretically, we shall obtain greater constancy by lower potential; but the diffusion takes place so slowly that the difference of potential of 1.0 volt, for example that of the muriatic cell, is still suitable for comparative measurements.

RESULTS OF OBSERVATIONS.

The combinations described in the following have this form when not otherwise specified:

$$Hg \mid Hg_2Cl_2 \mid S_1 \mid S_2 \mid Hg_2Cl_2 \mid Hg.$$

For simplicity only the solutions S are written.

We shall begin with the special case of equal total concentration, for which the equation of Planck takes the simple form:

$$\varphi_2 - \varphi_1 = \frac{R}{\varepsilon} \cdot \lg \frac{u_1 + v_2}{v_1 + u_2}.$$

Differences of potential between 1-10 normal solutions. In all the cells the current flowed from the first named solution to the second; in cells with mercury electrodes, that solution is in contact with the negative pole whose kathions possess the greatest velocity, in cells whose electrodes are solid metals, the speed of the anions preponderates.

	—E. M. Fs. in volt.—Observed.	Calculated.
H Cl | K Cl	0.0280	0.0282
H Cl → | NaCl	0.0333	0.0334
H Cl → | (N H_4) Cl	0.0290	0.0295
H Cl → | LiCl	0.0358	0.0358
K Cl → | NaCl	0.0050	0.0062
K Cl → | Li Cl	0.0075	0.0087
NaCl → | Li Cl	0.0024	0.0024
Ba Cl_2 → | Zn Cl_2	0.0014	0.00145
H Cl → | H NO_3 → | Li Cl	0.0370	0.0371
H Cl ← | K NO_3 → | Na Cl	0.0350	0.0355
Na Cl → | K NO_3 → | Li Cl	0.0026	0.0028
H Cl ← | K ClO_3 → | K Cl	0.0360	0.0368
H Cl → | H NO_3 → | K ClO_3 → | Na Cl	0.0375	0.0370
K Cl ← | H Cl → | K NO_3 → | Na Cl	0.0070	0.0073
H_2SO_4 ← | Zn Cl_2 → | Na_2 SO_4	0.0130	0.0151

Electrodes: Hg,	Hg_2SO_4	
$ZnSO_4$ | Cu So_4	0 0	0.0
H_2SO_4 | Na_2SO_4	0.0155	0.0152
H_2SO_4 | $ZnSO_4$	0.0152	0 0162
H_2SO_4 | $CuSO_4$	0.0145	0.0162
H_2SO_4 | $MgSO_4$	0.0180	0.0156

Electrodes:	Amalg. zinc observed.
$ZnCl_2$ | $ZnSO_4$	0.0342
ZnCl | $Zn(C_2H_3O_2)_2$	0.0302
$Zn(C_2H_3O_2)_2$ | $ZnSO_4$	0.0065

If we set up a three-membered cell so that a concentration-current is generated between two solutions, and let the two other solutions be equivalent and of chemically different salts, cells are obtained belonging together by pairs with identical end members. The cells of such a pair differ only in their intermediate members. A few examples are given later. The differences of potential between the two equally concentrated solutions are equal in both cells according to the principle of superposition, and are moreover in the same direction. On the other hand the concentration currents, which may be calculated according to Nernst, differ a great deal. Therefore, the differences of potential of the two cells must have different values which I will designate as limits.

The calculated and observed values agree.

0.1 HCl | 0.01 HCl | 0.01 NaCl = 0.1286	0.1280
0.1 HCl | 0.1 NaCl | 0.01 NaCl = 0.0732	0.0727
0.1 HCl | 0.01 HCl | 0.01 LiCl = 0.1308	0.1309
0.1 HCl | 0.1 LiCl | 0 01 LiCl = 0.0698	0.0702

If in these combinations we leave out the intermediate members, the two cells belonging to one pair become

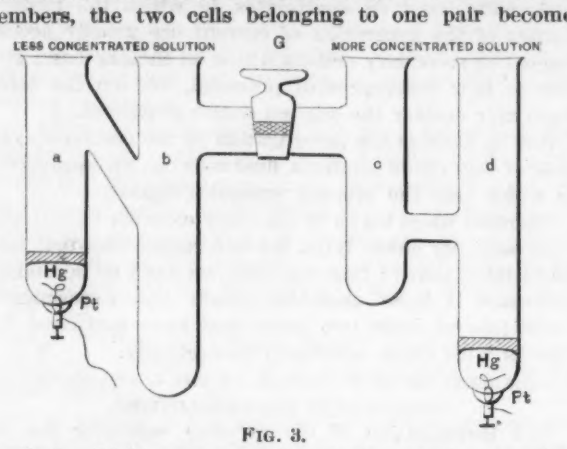


Fig. 3.

identical, which represents the most general case of a fluid cell with two differently concentrated, chemically different solutions. For the difference of potential of such a two-membered cell of the most general form the following law holds:

The difference of potential of chemically different solutions of any concentration always lies between the two limiting values, which are obtained, if we interpolate two intermediate members, in such a manner that a concentration current and a difference of potential between equally concentrated solutions arise.

(To be continued.)

A New Carbon Electrode.

M. Girard, after a number of experiments upon mixtures for the electrodes of primary batteries of carbon, powdered metals, or better, of the powders of salts of metallic oxides, which are much more easily pulverized, has devised a new electrode which gives very satisfactory results. The proportions of the mixture are as follows: litharge, 75 per cent.; carbon, 15 per cent.; tar, 10 per cent. The homogeneity of this mixture is obtained by a special process of manufacture. This electrode will also give very good results in accumulators.

Commercial Electrolysis.—I.*

BY EMILE ANDREOLI.

A few months ago Mr. J. Swinburne read at the Institution of Electrical Engineers a paper on the "Problems of Commercial Electrolysis," which has since been published in all the technical papers in this country, as well as in America, France, Germany, etc. Since then I have been watching for a criticism of this work, in which Mr. Swinburne had incorporated the essence of other articles on the electrolysis of chlorides which he had written for *Industries*, and which also went the rounds of the electrical press in both hemispheres; but, to my great surprise, the whole has passed without comment, and Mr. Swinburne's suggestions and notions were seemingly accepted without controversy, protest, or discrimination. A short time before Mr. J. W. Swan, at the Royal Institution, and Mr. H. Fontaine, at the Société de Physique, in Paris, delivered lectures on the progress of electrolysis and especially of electro metallurgy, but the object of these competent men was merely to give an exposé of the development of electrolysis, especially in connection with the deposition of metals, while Mr. Swinburne's ambitious programme is to foresee the direction in which others must seek for future developments, in the hope that it will lead to the expression of the views both of electrical engineers and of manufacturing chemists, and to a further approach to common ground.

I respect Mr. Swinburne very much when he speaks of dynamos or apparatus which, like transformers, are his specialty, but when he treats ex cathedra the question of electrolysis and its problems, I feel greatly encouraged in submitting my modest remarks to the attention of the electricians and of electro-chemists. Unless what Mr. Swinburne said is not contradicted or refuted, every person interested in electrolysis, every student who will devote himself to electrolytic researches and experiments, will believe that the ideas expounded in the "Problems of Commercial Electrolysis" are accurate scientifically and practically true. Therefore, I thought I might say my word on this paper, which, if instead of having been written by Mr. J. Swinburne, had been simply an article of popular science, signed by an unknown electrician, would never have been noticed.

This opuscule is a sort of challenge? No one in the press has yet taken up the gauntlet, and I doubt very much whether the Institution of Electrical Engineers will discuss the "Problems of Commercial Electrolysis," which is merely a compilation accompanied by comments; at all events, I hope Mr. Swinburne will not take in bad part the criticisms I will briefly and rapidly make of his dissertation. His statement that commercial electrolysis does not involve any mystery, and that it is a method of oxidizing and reducing and nothing more, may be correct when applied to accumulators; but everything is somewhat mysterious or almost unknown when secondary reactions take place, as is the case in many electrolytic operations, such as the decomposition of a chloride of sodium solution, which shows the formation of chlorine, hydrogen, hydrochloric acid, hypochlorite, chlorates, soda, reduction of hypochlorite, etc.

Commercial electrolysis does more than oxidize and reduce, in this sense, that it must cheaply decompose, separate, or combine certain products, and this formation or extraction of substances is the real difficulty to overcome, and what renders this task harder is that the conditions for solving the problems are different for almost every branch of industry which electro-chemistry seeks to appropriate from the domain of ordinary chemistry.

Shall I be blamed if I say that I dispute this calculation of the cost of electrical energy, which, according to Mr. Swinburne, if a plant put up to give a million watts is running day and night, and if the best engines and the best dynamos are employed, costs about 0.25d. per kilowatt hour? This estimate is theoretically true, it is the expression of the ideal of cheapness under exceptional circumstances, but the average cost of electrical energy in existing factories is more, much more, than one farthing.

OXYGEN.

I merely quote the estimate given by Mr. Swinburne, which shows that allowing two volts as the pressure requires, the cost of oxygen formed from an alkaline solution by electrolysis with iron electrodes comes out at 5s. 7d. per 1,000 cubic feet, and that as the output in oxygen must be small, we must take a much higher figure than one farthing per kilowatt hour, double the price and say 11s. 2d. Besides, Mr. Swinburne speaks of packing the oxygen in cylinders and of adding the trade charges, and brings the price up to something like 15s. per 1,000 feet, while the retail price of Brin's oxygen is 2d. per cubic foot, equal to £8 6s. 8d. per 1,000 feet.

According to the experiments made by Scheurer-Kestner two years ago, 12½ h. p. produce in one hour 1 kilo. of oxygen, representing 700 litres at 0.760° and 125 grammes of hydrogen, representing 1,400 litres, therefore 1,250 h. p. would give 100 kilos. oxygen = 7,000 litres.

At 1½ kilo. of coal per h. p., 12½ h. p. cost 18 kilos. of coal; consequently 1 kilo. of electrolytic oxygen costs 36 centimes for fuel only.

Latchinoff and Commandant Renard have recently produced some very remarkablo improvements in the cheap production of oxygen.

Where is the problem for the Institution of Electrical Engineers?

ALKALI.

The electrolytic production of soda is a much more serious and delicate matter, and Mr. Swinburne has, I regret to say, the most strange ideas on the production of hypochlorite, or of chlorine and caustic soda. Where on earth has he found that salt costs about 15s. a ton, and that 3 volts, with a reasonable current density, is a liberal allowance? On what grounds can he safely base his estimate of a ton of 70 per cent. caustic soda and 1½ ton of bleaching powder at £5 0s. 6d.?

Electrical energy	£2 15 0
Salt	1 2 6
Lime	1 3 0
	£5 0 6

No doubt, electrolytic chlorine and soda are cheap, but the cost of electric energy and salt is more than Mr. Swinburne represents it to be, and if the item of lime is 23s., salt must be more than 22s.

I will not cruelly insist on some heretical ideas professed by the inventor of the "hedgehog," but I would like to see how he would successfully demonstrate that in the production of electrolytic soda and bleach, "the difficulty, as he believes it, and the only difficulty lies in the anodes."

No doubt the destructibility of anodes is a great obstacle to the progress of commercial electrolysis; but the evil is not so terrible as Mr. Swinburne says, and he paints the devil blacker than he really is, or is supposed to be. Another time I will treat of the rôle of the anodes, and especially of the carbon anodes in the electrolysis of chlorides; but, in doing so, I will base my arguments on facts. Mr. Swinburne quotes Bartoli and Papasogli, who, in 1882, pointed out that carbon was attacked when used in any solution which evolves oxygen. "Without knowing of their works," says he, "I found the same by a series of experiments carried out in 1883."

If my memory is good these experiments were made in connection with a carbon anode for a secondary battery constructed by Mr. Swinburne, and I take this opportunity to say that Bartoli and Papasogli had not the good fortune of having their admirable work on "Electrolysis by Means of Carbon" translated into different languages as the "Problems of Commercial Electrolysis" have been. The fact is that, excepting a short extract on the formation of mellitic acid, I am not aware that their lectures and essays were even translated into English. Thus may all electricians know that under the action of sodic hypochlorite all natural or artificial forms of carbon are completely destroyed with

*From *Electrical Review* (London).

formation of bioxide of carbon, oxalic acid and mellitic acid (C_{12} H_6 O_{12}), and that under the influence of the electric current in an electrolyte of pure water or acidulated water carbon is oxidized and produces direct either mellitic acid or mellogen. But very few know how and why a carbon anode can resist the action of oxygen or chlorine and last for a long time in a chloride solution. I will not fail to publish at the earliest opportunity the full account of the experiments made by the two Italian scientists, and it will be accompanied with figures and details on the durability of anodes.

Mr. Swinburne, therefore, is not quite right when he says: "Though carbon does not seem to combine with chlorine during electrolysis, I find that it is always attacked, even in a solution of salt. I have tried every kind of carbon I can think of, and the result has always been that the anode was corroded."

I wonder what experience of carbon Mr. Swinburne may have, to state that carbon is also troublesome mechanically, and that it is difficult to make good contacts with it, especially when there is chlorine about.

If he agrees to give me a transformer of a given capacity, I am quite willing to have constructed for him a carbon anode measuring, say, two or three square yards, which he will be able to work for a very long time. I do not pretend this carbon plate will last forever; nothing is imperishable nor even insusceptible of change, but it will be of good service, and work long and well.

Is it not really exasperating to hear an electrician of such standing as Mr. Swinburne making this bold assertion: I am inclined to think that progress is barred in this direction solely by the want of a good anode. No, Mr. Swinburne! you may have the best, the cheapest and the most durable anodes; but if you do not have something more in your tank, if you do not know something else, if you have not passed the ordeals of experience, sometimes accompanied and very often unaccompanied with success, in the commercial production of hypochlorite or chlorine and soda, you will not obtain any good results, even with the best indestructible anodes.

I must confess that I do not quite understand what the writer of the "Problems of Commercial Electrolysis" says of his experiments on sodium sulphate, and of small traces of chloride left in the sulphate which corroded his lead anodes. But, passons! it would take too much space if I had to point out every criticisable point; it is sad to see that the destructibility of the anodes is such a dreadful nightmare for Mr. Swinburne that he constantly returns to this favorite topic: the corrosion of the anodes.

Why does he not speak of the unattackable anodes made of phosphide of chromium (Parker and Robinson), or of ferro silicon or of an alloy of iron and titanium (C. Hopfner)?

I expected Mr. Swinburne would have, in his usual masterly fashion, handled this question of hypochlorite, which was and is still generally considered as the most important problem of commercial electrolysis, but he hardly touched it, and simply, en passant, spoke of hermite, and once more renewed his complaint about the anodes, as if the whole difficulty of the production of electrolytic hypochlorite were surmounted by the use at the positive pole of a substance which is not attacked by chloride of oxygen.

"For paper work it is obviously cheaper to supply the lime and get bleaching powder and caustic, than to make sodium hypochlorite only. This may, however, depend on the anodes. Platinum anodes are used in this process, and it seems to be the case that platinum is not attacked in an alkaline chloride. If this is so, it is possible to produce hypochlorite of soda, but not caustic and bleaching powder." Evidently Mr. Swinburne does not see the point, as it is quite immaterial whether the hypochlorite is produced by means of carbon or platinum anodes.

We must now recognize as an undeniable fact that an electrolytic hypochlorite solution is not considered as an economical bleach by the paper makers; we must bow to such a decision, and, therefore, there is no longer any prospect for the electrolysis of chlorides in view of forming a substitute for bleaching powder.

Hereafter I will give an estimate made some time ago, and which the electrician who made it repudiates now in the most complete manner because he finds it more advantageous to produce chlorine for making bleaching powder or another strong hypochlorite than to transform a chloride solution into a weak hypochlorite. "Assuming that the yield of the electrolysis of a solution of chloride of sodium is only 1 gramme per ampère hour, a dynamo of 1,000 ampères and 5 volts will produce 1,000 grammes (1 kilo.) of pure active chlorine per hour, equal to 24 kilos. per day of 24 hours. A dynamo of 1,000 ampères and 100 volts will consequently produce twenty times more chlorine, and the yield will be 20 kilos. per hour in the 20 tanks, *i. e.*, 1 kilo. per hour in each tank, which represent 480 kilos. of chlorine per day of 24 hours, or 1,056 pounds of chlorine. Given that chloride of lime contains 33 per cent. chlorine, this quantity of active chlorine produced by electrolysis is equivalent to 3,168 pounds, nearly 1½ tons of bleaching powder.

"If, instead of 1 dynamo, two dynamos supply each 1,000 ampères and 100 volts, and 40 tanks, the yield of chlorine will be doubled, and at the end of 24 hours we shall have 960 kilos of chlorine, corresponding to 6,336 pounds of chloride of lime, *i. e.*, more than 2¾ tons.

"Supposing the engine driving the two dynamos to be of 300 I. H. P., requiring 3 pounds of coal per I. H. P. per hour, *i. e.*, 900 pounds of coal per hour, equal to 21,600 pounds per day of 24 hours, a little over 9 tons at, say, 10s. per ton; this will cost £4 16s., to which if we add £4 4s. for labor, salt, oil and sundries (which is a great deal too much), the equivalent of 2¾ tons of bleaching powder will cost £9, while at the price of, say, only £6 5s. per ton, the same quantity of bleaching powder would cost £17 4s."

All this is well and good; but even assuming that the hermite process allows us, as inacurately stated by Messrs. Raoul Pictet, Lacombe, Heilmann and Cross, and Bevan, to obtain 1.56 gramme to 1.80 gramme of chlorine per ampère hour, which, if it were true, would be much more than the theoretical yield, it does not pay in the bleaching of paper pulp and fibre to substitute hypochlorite of magnesium or sodium for chloride of lime, as in the transformation of a chloride solution into hypochlorite part only of the salt is decomposed, and the largest quantity which an electrolytic hypochlorite may contain is a little more than 3 grammes per litre. If attempts are made to make the solution stronger and raise its chlorometric strength to 4 grammes, heat is developed, chlorate is formed, the hypochlorite is reduced, there is a waste of electricity, and the liquid is spoiled. Therefore, to get 1 kilo. of chlorine, it requires 300 litres of liquid, and when this weak bleach is exhausted there is a considerable loss of salt.

The following figures were given to me by a manager of a large paper mill; from them every one can draw his conclusions, and form an idea of the quantity of water required and of salt lost, in bleaching 20 or 40 tons of pulp per day.

1st. Twenty cwts. of raw esparto (or 10 cwt. of air dried pulp) carry 2,324 gallons of water, which is made up of 2,068 gallons water and 256 gallons bleach liquor.

2d. With the present arrangement of drum washer, I can wash out of the above 556 gallons, which represents what water can be got back.

3d. By experiment I find that the bleach liquor of six degrees Twaddell's hydrometer contains 18.7 grammes of chlorine per litre, and that the 2,324 gallons, or 10,559.3 litres of water and bleach liquor contain 2.1 grammes of chlorine per litre, which is the strength in the potcher.

From the above we can see that Mr. Swinburne in his paper does not deal really with the problems of commercial electrolysis; he does not seem to realize the difficulties with which electricians have to contend in making hypochlorite or chlorine and caustic soda.

Last month I saw in London one of the largest paper makers in America, who had a great experience and knowledge of electrolytic hypochlorite. We spent a very great amount of money, he said, in experimental and practical applications of electrolysis in our mills in the production of hypochlorite, but we were compelled to abandon it, as the quantity of chlorine contained in the bleach is too small in comparison of the salt which is of no use in the potcher and which is afterward lost. Bleaching by hypochlorite is an utopia, an utter chimera, a nonsense, and what we demand now of electricity is to supply us with chlorine and soda.

(To be continued.)

The Meeting of the American Institute of Electrical Engineers.

The seventy-first meeting was held at the headquarters of the institute on Tuesday, Nov. 15, and in spite of the inclemency of the weather the attendance was quite large. The paper presented by Dr. J. B. Williams at Chicago last June upon "Oil vs. Air as an Insulating Medium" was brought up for discussion. A quadrant electrometer and the other necessary apparatus for making practical insulation tests were set up and the members were given an opportunity of seeing the insulating properties of various materials actually tested. Dr. Williams was unable to obtain the room in season to make all the necessary preparations, but the tests, while not as complete and satisfactory as he desired, proved to be of considerable interest. A number of oils were tested, and it was shown that paraffine oil was a better insulator than cotton seed oil, while resin oil was very much better than either. A large number of samples of wires manufactured by different companies had been sent in and a few of these were also subjected to tests. The vulcanized wires seemed to show much better results than the others. As there was neither time nor opportunity to make a careful comparison of all the samples, Dr. Williams kindly offered to make a careful test of the different wires in his laboratory and present a written report of the result to the institute at some later date. This proposition was accepted and after a vote of thanks to Dr. Williams the meeting was adjourned.

At the meeting of council the following associate members were elected: Craig R. Arnold, Electric Manufacturing Company, Chester, Penn.; Ludwig K. Bohm, Ph D.; Edward Durant, New York City; Horace B. Gale, San Francisco, Cal.; Fred S. Hunting, Fort Wayne Electric Company, Fort Wayne, Ind.; James F. McElroy, The Consolidated Car Heating Company, Albany, N. Y.; Th. Stahl, Creusot Works, Creusot, France.

The following associate members were transferred to full membership, their applications having been approved by the Board of Examiners: Frank Bourne, Field Engineering Company, New York City; Benj. F. Thomas, Professor of Physics, Ohio State University, Columbus, O.; Alexander J. Wurts, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.; George R. Metcalfe, *Electricity*, New York City; Lewis B. Stillwell, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

CHILLING (PAWEL LWOWITCH), Baron (of Canstadt), attaché to the Russian Embassy in Munich, and who had been two years before associated with S. T. Von Sömmering (Kuhn, p. 836) devises what he calls his "subaqueous galvanic conducting cord"—a copper wire insulated with a thin coating of india-rubber and varnish. This was laid both underground and under the sea, and, by means of an arrangement of charcoal points, he was enabled to explode powder mines across the Neva, near St. Petersburg, and also across the Seine during the occupation of Paris by the allied armies.[1]

From the moment Schilling first saw the telegraph of Sömmering (Aug. 13, 1810) he made many experiments,[2] with the view of introducing it into Russia, finally taking a model of his friend's apparatus to St. Petersburg during the year 1812,[3] and Hamel states (at page 41 of Cooke's reprint) that one of his contrivances was exhibited to the Emperor Alexander as early as 1825 (Dr. E. N. Dickerson in his Henry Memorial Address before Princeton College gives the date as 1824). Be that as it may, it was only after his return from China in 1832 (two years after Sömmering's death) that, following Ampère's suggestion as to the availability of Oersted's discovery, he submitted the apparatus which established for him the credit of having invented the electromagnetic telegraph.

Many authors have erroneously described Schilling's apparatus as consisting of a number of platinum wires insulated and bound together with a silken cord, which put in motion, by means of a species of key connecting with a galvanic pile, 36 magnetic needles placed vertically in the centre of the multiplier. This account appeared at p. 43 of the *Journal des Travaux de l'Acad. de l'Industrie Francaise* for March, 1839. The fact is that he employed but one magnetic needle and multiplier, with two leading wires, as proposed by Fechner, and was enabled by means of a combination of the deflections of this needle to the right and left—for instance, one deflection to the right might denote *e*, two *i*, three *b*; one deflection to the left *t*, two *s*, three *v*—to give all the signals necessary for a complete correspondence by changing the poles of the battery at the ends of the wires. His call signal was given by means of an alarm consisting of a bell in connection with a clockwork, which was released by the deflection of a magnet.[4]

From the account of the telegraphic collection at the 1873 Exposition published by Dr. Ed. Zetzche in the "Austellungblatte" of the Vienna *Neue Freie Presse*, the following is extracted: Even after Professor Oersted, of Copenhagen, had observed the deviation of the magnetic needle under the influence of the current, neither the proposition of Ampère, at Paris, in 1820 (of employing 30 needles and 60 wires), nor that of Fechner, at Leipsic, in 1829 (24 needles and 48 wires), gave any impulse to telegraphy. Only in 1832 did the Russian Councillor of State, Baron Schilling de Kannstadt, of German origin, who had seen the telegraph of Sömmering, with whom he was intimately associated, and had made it known in Russia, invent a new instrument with but five wires, which number he subsequently reduced to one. A design only of this telegraph was shown at Vienna, the original being preserved by the Académie of Sciences in St. Petersburg. In it the movements of the needle were rendered more perceptible by means of little discs of paper attached to a silk thread which held the needle in suspension. This telegraph, it is true, was not put in application on a large scale, for Schilling died in 1837. But, on the 23d of September, 1835, he had brought out his apparatus at Bonn and at Frankfort-on-the-Main, where it was seen, among other persons, by Professor Muncke, who probably constructed a similar one and carried it with him to Heidelberg.

It was only one year before his death that Schilling succeeded in obtaining the support of the Russian government for his telegraph, and it was after Muncke had shown it (March 6, 1836,) to William Fothergill Cooke, then a student in medicine at Heidelberg, that the latter produced his needle telegraph, which was followed by Cooke and Wheatstone's still more perfect instrument in 1837,[5] some improvements in Schilling's so-called deflective telegraph having in the meantime been made by Gauss and Weber, of Gottingen, and by Steinheil at Munich.

Prior to his visiting Bonn (Meeting of Naturalists—*Isis, Nog.*, 1836), Schilling had taken the working model of his telegraph to Vienna, where he made experiments with it in conjunction with Baron Jacquin and with Professor Andreas von Ettinghausen. Upon his return home from Germany, in 1836, he declined invitations made him to bring his instruments to England,[6] while by direction of the Russian Commission of Inquiry he set up an experimental telegraph in two chambers of the Palace of the Ad-

[1] T. Hamel, *Bull. Acad. Peterab.* ii, and iv.; also William F. Cooke's reprint, 1859, pp. 20-22; Fahie's "History," p. 309.
[2] Prime's "Life of Morse," p. 277.
[3] *Sci. Am. Supp.*, No. 405.
[4] A detailed account of the working of Schilling's telegraph will be found in J. S. T. Gehler's *Physikalisches Wörterbuch* for 1833, vol. ix., p. 111; Fahie's "History," pp. 310-313; and *Sci. Am. Supp.*, No. 405, p. 6,467.
[5] Prime's "Life of Morse," pp. 265, 276.
[6] Dr. Hamel's St. Petersburg lecture on "The Telegraph and Baron Paul Schilling."

miralty, connecting the apparatus by a long line over ground and by a cable laid in the waters of the canal. The results were so satisfactory that the Emperor Nicholas ordered a submarine line to be laid between St. Petersburgh and Cronstadt. This was in May, 1837, but Schilling's death, on the 6th of August following, prevented the execution of the project.[7]

A. D. 1812–1813.——Morichini (Domenico Pini), eminent Italian physician, is the first to announce, as an experimental fact, that unmagnetized steel needles can be rendered magnetic by making the focus of violet solar rays collected through a lens pass repeatedly from the middle to one end of the needle, without touching the other half.[8]

The long contention excited by this announcement and the ingenious experiments of Mrs. Somerville, together with the wholly negative results obtained by P. F. Riess and L. Moser, are detailed at page 48 of Brewster's, 1837, "Treatise on Magnetism." At page 12 of his article (vol. xiv. of the Eighth Britannica), Sir David Brewster states that Morichini's experiments were successfully repeated by Dr. Carpi at Rome, and the Marquis Ridolfi at Florence; but Mr. d'Hombre Firmas, at Atlais, in France; Prof. Configlachi, of Pavia, and Mr. Berard, of Montpelier, failed in obtaining decided effects from the violet rays. In 1814 Dr. Morichini exhibited the actual experiment to Sir Humphry Davy, and in 1817 Dr. Carpi showed it to Prof. Playfair. A few months after Sir Humphry Davy witnessed the experiment, Sir David Brewster, met him at Geneva, and learned from him the fact that he had paid the most diligent attention to one of Morichini's experiments, and that he saw with his own eyes an unmagnetized needle rendered magnetic by violet light. Then follows the account of Dr. Carpi's experiment as given to Brewster by Prof. Playfair, also details of the investigations of Mrs. Somerville, Mr. Christie, Sir William Snow Harris, Prof. Zantedeschi, of MM. Baumgartner and Barlocci as well as those of Riess and Moser above alluded to.[9]

Peter (Pietro) Configliachi, who is named above, was the successor of Volta as Professor of Natural Philosophy at the Pavia University, and became editor of the "Biblioteca Fisica d'Europa" the "Biblioteca Germanica," the "Biblioteca Italiana" and the "Giornale di Fisica, Chimical Storia Naturale."[10]

A D. 1813.——Sharpe (John Robert), of Doe Hill, near Alfreton, transmits to the *Repertory of Arts* a letter, which appeared in its vol. xxix., 2d series, page 23, wherein he alludes to page 188, vol. xxiv., of the same series, containing an account of Sömmering's invention. He says:

> Without the slightest wish to throw a doubt over the originality of Mr. Sömmering's invention, I beg leave to mention that an experiment, showing the advantages to be obtained from the application of the certain and rapid motion of the electric principal through an extensive voltaic circuit to the purpose of the ordinary telegraph, was exhibited by me before the Right Hon. the Lords of the Admiralty, in the beginning of February, 1813.

It is said that the Lords of the Admiralty spoke approvingly of it, but stated that as the war was over, and money scarce, they could not carry it into effect.[11]

Ronald says:

> No description of this telegraph appears to have been printed. It was mentioned at the Admiralty after the invention and full description of Sömmering's, described fully and with figures in the Denkschriften of the Academy of Munich for 1809-10, printed in 1811.

Mr. Benjamin Sharpe, nephew of J. R. Sharpe, is the author of "A Treatise on the Construction and Submersion of Deep-Sea Electric Telegraph Cables," London, 1861, wherein he alludes to the above, and asserts that his uncle "conveyed signals a distance of seven miles under water."[12]

A. D. 1813.——Deleuze (Joseph Philippe Francois), French physican, publishes his "Histoire Critique du Magnétisme Animal," containing the result of the observations made by him during the previous 25 years upon animal magnetism.

In the words of Dr. Allen Thomson, of the University of Glasgow, Deleuze believed in the existence of an all-pervading magnetic fluid. This fluid is under the control of the will, and is constantly escaping from our bodies, forming around them an atmosphere, which, having no determinate current, does not act sensibly on the person near us; but, when urged and directed by our volition, it moves with all the force which we impress upon it, it is moved like the luminous rays emitted by substances in a state of combustion. The chief difference between the Deleuze and Puysegur schools has reference to the various modes in which the magnetic fluid should be brought into action, and the suitable occasions for its employment.

During the year 1815 the Magnetic Society was established in Paris, with Mr. De Puysegur as its president and Mr. Deleuze as vice-president, but it expired in 1820. In 1819 Mr. Deleuze had published his "Défense du Magnétisme Animal," in reply to the attack made upon the subject of Mr. Virey through the "Dictionnaire des Sciences Médicales," and he was followed, more particularly, by Mr. Bertrand, who issued in 1823 his "Traité du Somnambulisme," and in 1826 his still more important work, "Du Magnétisme Animal en France, etc." Respecting the last named Deleuze says:

> Of all the attacks directed against magnetism up to the present day, this is the most powerful, the most imposing, and the most ably combined. The author is a man of genius, etc. He has been occupied with magnetism for some years. He has joined its practice to that of medicine, and he has even taught its doctrines in public lectures. A more attentive examination and new experiments have dissuaded him from a belief which he himself propagated; he undertakes to undeceive others, and to prove that magnetism is a mere chimera. Certainly his conviction must be very strong.[13]

Oil Versus Air as an Insulating Medium.—I.*

BY JAMES BOWSTEAD WILLIAMS, M. D.

All who have attempted to enlarge in the smallest degree the bounds of our knowledge recognize the importance of the faithful collection of facts which, though seeming separately insignificant, may yet when brought together resolve themselves into distinct and important scientific truth. By combining the results of investigations carried on from different standpoints, we obtain a view of the subject more complete than any single mind, however masterly, could give us. Hence every item of information has its importance, as it may prove to some other investigator the exact clue to solve some long-pondered problem. Acting upon this principle, the writer now offers an account of some experiments made by himself to determine the comparative insulation resistance of oils and air; and it has appeared to him that the results obtained from these experiments are specially important from the fact that all of the apparatus used was absolutely insulated, and that the only leakage that could take place was through or across the various substances experimented upon.

The relative powers of oils and air to resist disruptive discharges and also to insulate alternating currents will not be considered at this time, as the writer proposes to reserve those subjects for a future paper.

The instruments used in the experiments from which the results about to be set forth in this paper were obtained were an electrometer, a discharge key, a 6-inch spark coil and a Grenet cell to operate it, and apparatus for holding the oils and other substances while they were being tested.

The electrometer was a special form of quadrant electrometer, designed and made by the writer in San Francisco, in 1886, for the purpose of testing insulating material generally, and particularly for determining the comparative internal resistance of very short pieces of insulated electric conductors. Its quadrants and needle system are similar to those of Lord Kelvin's electrometer, but the mounting of the quadrants and the needle suspension are different. No glass is used for insulating the various parts, this insulation being effected entirely by means of the best quality of hard rubber, which is well paraffined. The suspension is of the bifilar type, is about six inches in length and is provided with adjustments. The replenisher and gauge are contained in a separate vessel, and when they are electrically connected with the electrometer proper the combination can be used in the same manner and for the same purposes as the "White pattern' quadrant electrometer. The insulation of this instrument is so perfect that its quadrants, when charged to potentials of about 6,000 volts, will retain their charge for several hours without any perceptible leakage.

Before the electrometer is used for comparative testing, it is so adjusted that the quadrants, when fully charged, will be charged to any desired potential of from one to six thousand volts.

The discharge key resembles those in common use, the only difference being in the trigger, which is so constructed as to insulate as highly as any of the pillars of the key.

This instrument was used when time measurements were taken.

All of these instruments were illustrated, and the methods of using the same in making comparative tests of insulated wires explained, in the *Electrical Engineer* of March 30 and April 6, 1892, in a serial by the writer, entitled "Insulated Electric Conductors."

With this apparatus, using the same potential as that used in these experiments, the "dielectric after working" of Boltzman can be demonstrated, if a few inches of a highly insulated wire are tested. The variation of the capacity of a condenser having a small bare wire for its inner coating can be shown.

The apparatus in which the oils were first tested consisted of a glass cup to contains the oils and two circular brass discs, parallel to each other, which were immersed in the oil and between which layers of oil could be formed.

These discs were each 2½ inches in diameter, one of the discs, the lower, being fixed and the other, the upper, movable. The movable disc was soldered to the end of an adjustable screw passing perpendicularly through the centre of the hard rubber cover of the cup, which was three inches in diameter. The fixed disc was supported at the middle of a U shaped device formed of hard rubber tubes, both of the arms of which were cemented to the cover of the cup. One of these arms passed through the cover and extended about six inches above it, and contained the wire which was soldered to the fixed disc. The discs were absolutely insulated from each other and from the earth, and were separated one thirty-sixth of an inch by each revolution of the adjustable screw. The apparatus in which the second tests of the oils were made will be described later.

The method of testing the oils was briefly as follows. The needle of the electrometer, the induction plate and one pair of quadrants were electrically joined to the frame of the instrument and to earth, and the second pair of quadrants joined to the upper disc.

The lower disc was connected with the binding screws of the upper contact of the discharge key, the lever of the key being depressed and held against the lower contact of the key by the trigger. The lever of the key was joined to earth. Oil was then poured into the cup, sufficient to cover the upper disc when this disc was separated from the lower disc by one-half inch, this being about the effective range of the screw.

The quadrants, and of course the upper disc, were then charged by sparks from the coil to a potential of about 2,300 volts, the illuminating apparatus and scale having previously been adjusted so that when the quadrants were fully charged the image of the cross wire would settle at the upper end of the scale, at 300, say.

As the quadrants and discs were absolutely insulated at the potential used, there could be no leakage of the charge as long as the lower disc remained insulated from the earth; but as soon as this disc was connected with the earth, either through the medium of the discharge key or by having its electrode touched with a wire fastened to the gas pipe, leakage would take place through the layer of oil, whatever its thickness might be between the discs; and the rate at which the leakage took place was indicated by the rate at which the image of the cross wire passed down the scale, *i. e.*, by the rate at which the electrometer was discharged.

Before entering into a description of the experiments I wish to refer to a phenomenon which occurs when all good insulating material is tested by means of charges of high potential, if the material forms the dielectric of a condenser.

Take any highly insulated wire and form, say four inches of it, into a condenser by closely wrapping the dielectric with tinfoil, and then carefully paraffine the ends to prevent surface leakage. The condenser thus formed is absolutely insulated from earth, and connected with the electrometer and discharge key in the same way as the condenser formed by the two discs and the layer of oil between them, *i. e*, by connecting the wire with the quadrants, and the tinfoil with the upper contact of the key. The quadrants are then charged to potentials of 2,000 volts or more. This causes the needle of the electrometer, and with it the image of the cross wire, to be violently deflected to the right or left, depending upon which pair of quadrants is used. The needle then vibrates, but each succeeding vibration becomes quicker and shorter until the image finally settles at 300, say.

Now, if the trigger of the key be made to release the lever, connection is made between the tinfoil and the earth. A sudden "drop" of the image then occurs, which is due to the rapid absorption of a portion of the charge by the dielectric. The needle again vibrates, but the image soon settles at 250, say, if the wire be very highly insulated, and will remain at 250, thus showing that there is practically no leakage. But if the wire be a little less highly insulated, the drop still occurs, but the image simply "hesitates," as it were, at 250, say, and then passes slowly down the scale in proportion to the amount of leakage which is taking place through the dielectric. If the ground circuit be now broken by depressing the lever of the key, the quadrants again charged to the same potential as before, and the ground circuit established, the drop is then very slight, oftentimes nil, and the falling of the image along the scale is now due to the leakage through the dielectric and not to absorption by it.

No absorption of the charge by the dielectric can be detected as long as the outer coating of the condenser is insulated. If the image should move, there is leakage in some portion of the testing apparatus, which must be remedied if the tests are to have any value. This drop is observed only when the best kinds of insulating material are tested by the method just described. It cannot be detected when the poorer qualities of insulating material are subjected to the same tests on account of the rapid leakage through them.

The potential of the charge was determined in the following manner: The length of spark produced by suddenly discharging the quadrants in air was approximately determined by bringing a pointed wire, held in the hand, close up to the electrode of the charged quadrants. Two bright tin discs, each one and one eighth inches in diameter, were then rigidly cemented upon the ends of two stout hard-rubber tubes which were well paraffined. These tubes were fastened together at the other ends in such manner that by inserting a wedge between them the discs could be separated or made to approach each other and still remain substantially parallel at the striking distance of the spark. One of the discs was joined to the quadrants and

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[7] See biography in *Sci. Am. Supp.*, No. 547, p. 8,737; *Polytechnic Central Journal*, Nos. 31, 32 for 1838; *Lumière Electrique*, for March 17, 1883; "Allg. Bauztg.," 1837, No. 52, p. 440; Vail's "History," p. 155; Hibbard's Ec. 31; Channing Ec. 41; Poggendorff, vol. ii., p. 793; *Annales Télégraphiques* for November to December, 1861, p. 670; *Journal Soc. of Arts* for July 22, 1859, p. 598; References at Ronald's "Catalogue," p. 457; Du Moncel, "Exposé," vol. iii., p. 8, and "Traité Théorique et Pratique du Tel. Elect.," Paris, 1864, p. 217; *Comptes Rendus*, vol. vii. for 1838, p. 82; *Journal Franklin Inst.* for 1851, p. 60; H. F. E. Lenz "Uber die Praktische . . . Galvanismus." 1839.

[8] Zantedeschi, ii., 214.

[9] See "Elogio storico del Cavaliere D. Morichini in *Mem. della Soc. Ital.*," vol. xxvi., p. 3; Riess and Moser in *Phil. Mag. or Annales*, vol. viii., p. 155, 1830, and in Edinb. *Trans.* vol. x., p. 123; "Library of Useful Knowledge" (El. Mag.) p. 97; *Zeitschrift*, vol. i., p. 263; Noad, "Manual," pp. 532, 533, the article of Col. George Gibbs in Silliman's *Amer. Jour. of Sci.*, 1818, vol. i, pp. 80, 90; *Annales de Chimie*, vol. xiii., p. 304; Brewster's "Optics," p. 92, also articles "Optics," p. 596, "Light," p. 432, and "Electricity," p. 563, of the Eighth "Britannica;" *Edinb. Jour. of Sci.*, No. 4, p. 225; B. Gandolfi, "Antologia Romana," 1797; Harris, "Rud. Mag.," parte i., ii., p. 69; *Phil. Trans.* for 1826, pp. 132, 219; D. Olmstead, "Int. to Nat. Phil.," 1835, vol. ii., p. 191. See also Thomas Thomson's "Outline of the Sci.," p. 514, and Berzelius' "Traité de Chimie," vol. i., p. 138, for Morichini's observations on galvanic energy.

[10] See Larousse, "Dict. Univ.," vol. iv., p. 908; J. J. Prechtl, in Schweigger's *Journal*, vol. iv., for 1812; Fr. Mochetti, "Letter a al P. Configliachi," Como, 1814.

[11] Saturday *Review* for Aug. 21, 1858, p. 190.

[12] See Fahie's "History," pp. 244-246; *Sci. Am. Supp.*, No. 404, p. 6,446.

[13] See article "Somnambulism," in the "Britannica," more especially for a review of, and extracts from, Deleuze's great work, also the translation of the latter by T. C. Hartshorn, of which the enlarged fourth edition was published at London in 1850, accompanied by notes and a life of Dr. Foissac.

* A paper read at the General Meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 8.

the other to the discharge key. The quadrants were then fully charged and the key closed. If a spark passed between the discs, they were separated a little farther apart and the test repeated. If a spark did not pass, the discs were brought a little closer together and the test again repeated. After several trials the discs were separated at a distance corresponding to the exact length of the spark.

Slips of thin writing paper were then inserted between the discs until they exactly filled the space between them and the thickness of the layer formed by the paper measured with a Brown & Sharp micrometer gauge.

A suitable spark electrometer provided with parallel plates would have given the spark length by a direct reading, but the writer did not have time either to make or procure one.

The length of spark was found to be .03 of an inch. From tests made with a Thomson static voltmeter, this length would correspond to a potential of about 2,300 volts. (A spark .026 inch long = 2,000 volts.)

But whatever the potential of the charge may have been—whether it was two, three, or 5,000 volts—the same potential was used in all of the experiments described in this paper.

(To be continued.)

Electrical Exhibitors at the World's Fair.

The following list contains the names of all electrical firms and individuals who have signified their intention of making an exhibit at Chicago next year :

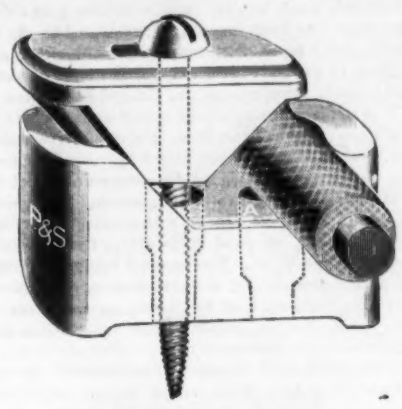
Amateur Electrician, The, Ravenswood, Ill.
American Bell Telephone Company, The, 125 Milk street, Boston.
Anthony Electrical Instrument Company, The, 9 Metropolitan block, Chicago.
Arnold Electrical Manufacturing Company, Chester, Pa.
American Exhibition Company, Ledger Building, Philadelphia, Pa
American Graphophone Company, 619 Fourteenth street, Washington, D. C.
Adler, Leon D., 11 Sidney Place, Newark, N. J.
Akron Electrical Manufacturing Company, Akron, O.
American Tanning Company, The, 46 Wall street, New York City.
Bain Electrical Manufacturing Company, 47 South Jefferson street, Chicago.
Brooks, R. T., 82 John street, New York City.
Brooks, John C., Paterson, N. J.
Brush Electric Company, The, Cleveland, O.
Bryan, Enholm & Co., 136 Liberty street, New York City.
Billings & Spencer Co., The, Hartford, Conn.
Belknap Motor Company, Portland, Me.
Bottome, Turner D., Hoosick, N. Y
Berliner, E., Columbia Road, Washington, D. C.
Brady, T. H , New Britain, Conn.
Barton Bell Company, Marion, Ind.
Blodgett Manufacturing Company, 1602 Ashland Block, Chicago.
Butler Hard Rubber Company, The, 33 Mercer street, New York City.
Beacon Vacuum Pump and Electrical Company, Irvington street, Boston.
"C. & C." Electric Motor Company, The, 402 Greenwich street, New York City.
Cutter, George, 333 "The Rookery," Chicago.
Crocker-Wheeler Electric Company, 430 West Fourteenth street, New York City.
Consolidated Electric Storage Company, Drexel Building, Philadelphia, Pa.
Commercial Cable Company, The, 1 Broadway, New York City.
Cook, Victor A., 195 Dearborn avenue, Chicago.
Chicago Electric Wire Company of Wilmington, Wilmington, Del.
Chicago Society of Operative Electricians, 1303 Chamber of Commerce Building, Chicago.
Chicago Magnetic Shield Company, 6 Central Music Hall, Chicago.
Commercial Electric Company, Indianapolis, Ind.
Columbia Incandescent Lamp Company, The, 1912 Olive street, St. Louis, Mo.
Central Electric Company, 115 Franklin street, Chicago.
Cross, Frank, Washington, Indiana.
Cregier, Dewitt C., Jr., 418 E. Chicago avenue.
Davy Electric Belt and Appliance Company, The, Evansville, Wisconsin.
Duplex Electric Company, Corry, Pa.
Dayton Fan and Motor Company, The, Dayton, Ohio.
Devey, Matthew H., 353 Parker street, Chester, Pa.
DuLaney Clock Company, The, 79 Dearborn street, Chicago.
Detroit Electric Works, The, Detroit, Mich.
Day, S. A., 166 Fulton street, New York City.
Delaware Hard Fibre Company, Wilmington, Del.
Electrical Merchandise Company, 11 Adams street, Chicago.
Electrical Supply Company, The, 171 Randolph street, Chicago.
ELECTRICAL WORLD, THE, Times Building, New York City.
Eureka Electrical Company, 18 Broadway, New York City.
Elgin Telephone Company, Elgin, Ill.
Empire Gold and Silver Plating Works, 75 Nassau street, New York City.
Engineering Equipment Company, 143 Liberty street, New York City.
Eureka Tempered Copper Company, North East, Erie County, Pa
Electrical Industries Publishing Company, Monadnock Building, Chicago.
Edgerton, N. H., 609 Commercial street, Philadelphia, Pa.
Electric Gas Lighting Company, The, 20 Lakeside Building, Chicago.
Electrical Forging Company, 163 Oliver street, Boston.
Electrical Engineer, The, 150 Broadway, New York City.
Electrical Review, 32 Park Row, New York City,
Electricity Newspaper Company, 6 Park Place, New York City.
Electric Secret Service Company, 45 Broadway, New York City.
Electric Engineering and Supply Company, N. Y.
Electric Heat Alarm Company, 113 Devonshire street, Boston.
Eddy Electrical Manufacturing Company, The, Windsor, Conn.
Electrical Advertising and Display Manufacturing Company, 134 South Seventh street, Philadelphia, Pa.
Electrical Machine Company, 1008 Title and Trust Building, Chicago,
Electrical Appliance Company, 242 Madison street, Chicago.
Excelsior Electrical Company, 42 Broad street, New York City.
Egan, Chas. E., Englewood, Ill.
Empire China Works, 134 Green street, Brooklyn, N. Y.
Electrical Age Publishing Company, The, World Building, New York City.
Electro Medical Battery Company, The, 128 Main street, Kalamazoo, Mich.
Edgerton, E. M., 301 Sixty-third street, Chicago.
Electrolibration Company, Birmingham, Ala.
Edison, Thos. A., Orange, N. J.
Field Engineering Company, 143 Liberty street, New York City.
Fibre Pipe Company, Mechanicsville, N. Y.
Fort Wayne Electric Company, Fort Wayne, Ind.
Ford-Washburn Storelectro Company, The, Cleveland, Ohio.
Franklin Elec. Appliance Company, 141 Milk street, Boston.
French, H.W., & John Warren, 833 Exchange Building, Boston.
Guillaume, Alfred, 215 Dearborn street, Chicago.
Gray, Elisha, Highland Park, Ill.
Greeley, The E. S. & Co., 5 and 7 Dey street, New York City.
Goodwin, F. O., Philadelphia, Pa.
General Electric Company, The, New York and Boston.
Gamewell Fire Alarm Tel. Company, The, 901 Ashland Block, Chicago.
Germania Elec. Company, 620 Atlantic avenue, Boston.
Great Western Electrical Supply Company, 195 South Canal street, Chicago.
Hanson & Van Winkle Electrical Company, The, 35 and 37 South Canal street, Chicago.
Heisler Electrical Company, Drexel Building, Philadelphia.
Hirlimann, Chas. J., 117 Macdougal street, New York City.
Hornell Iron Works, Hornellsville, N. Y.
Hall, Chas. Fred., New Grand Hotel, Plymouth place, Chicago.
Huestis, Chas. D. C., Fort Wayne, Ind.
Holmes, Nathaniel L., Delta Upsilon House, Ann Arbor, Mich.
Houlehan, James, 49 North Clark street, Chicago.
Hope Electrical Appliance Company, Providence, R. I.
Interior Conduit and Insulation Co., 42 Broad street, New York City.
India Rubber Comb Company, The, 9 Mercer street, New York City.
International Electric Railway Company, Commerce Building, Chicago.
Illinois Alloy Company, The, 41 Portland Block, Chicago.
Indiana Insulated Wire and Rubber Company, Jonesboro, Ind.
Jenney Electric Motor Company, Indianapolis, Ind.
Johns Manufacturing Company, The H. W., 87 Maiden Lane, New York City.
Johnson Electric Company, Cleveland, O.
Kirwan Electrical Indicator Company, Wilkesbarre, Pa.
K A. P. Electrical Novelty Company, The, South Second street, La Crosse, Wis.
Lang, J. & Co., 44 Michigan Street, Chicago.
La Roche Electrical Works, 116 North Sixth street, Philadelphia, Pa.
Leclanche Battery Company, The, 111 East 131st street, New York City.
Leatheroid Manufacturing Company, Kennebunk, Maine.
McIntire Company, The C., 13 Franklin street, Newark, N. J.
Munson Lightning Conductor Company, Indianapolis, Ind.
Marcus, Wm. N., 218 North Second street, Philadelphia, Pa.
Moore, Alfred F., 200 North Third street, Philadelphia, Pa.
Mather Electric Company, 9 Metropolitan Block, Chicago.
Mather, A. C., 169 Adams street, Chicago.
Munson Belting Company, 86 South Canal street, Chicago.
Municipal Fire and Police Telegraph, Highlands, Mass.
Mason, Jas. H., 120 Park avenue, Brooklyn, N. Y.
McCaskey, Alfred S., & J. A. Ellis, Union Club, Chicago.
Manhattan Electrical Supply Company, 36 Cortlandt street, New York City.
New York Insulated Wire Company, 15 Cortlandt street, New York City.
National Electric Manufacturing Company, Eau Claire, Wis.
Newman Clock Manufacturing Company, 124 Van Buren street, Chicago.
Norwich Insulated Wire Company, 112 Greene street, New York City.
New England Butt Company, Providence, R. I.
North American Electric Company, 14 Ann street, New York City.
New York and London Electric Association, 1921 Main street, Kansas City, Mo.
National Carbon Company, Cleveland, O.
Owen, Dr. A , 251 State street, Chicago.
Perkins, Frank C , 103 East State street, Ithaca, N. Y.
Paiste, H. T., 1201 Market street, Philadelphia, Pa.
Page Belting Company, 185 Lake street, Chicago.
Pumpelly, James R , 205 South Canal street, Chicago.
Pennock Battery, Electric Light and Improvement Company, 334 Dearborn street, Chicago.
Perkins Electric Lamp Company, The, Metropolitan Block, Chicago.
Phœnix Glass Company, 43 Sixth avenue, Pittsburgh, Pa.
Praul Rotary Steam Engine Company, 216 South Seventh street, Philadelphia, Pa.
Phelps, A. H., M. D., Glens Falls, N. Y.
Wm. Powell Company, The, Spring Grove avenue, Cincinnati,
Perry & Runlett, 25 Stickney street, West Lynn, Mass.
Pulvermacher Galvanic Company, Cincinnati, O.
Pratt Electro-Medical Supply Company, The, 75 Madison street, Chicago.
Quin, J. B , 521 Sixth avenue, Louisville, Ky.
Quinby, Wm. C., 326 Pine street, San Francisco, Cal.
Queen & Co., Jas. W., 924 Chestnut street, Philadelphia, Pa.
Railway Equipment Company, 11 Adams street, Chicago.
Revell, Alex., Wabash avenue and Adams street, Chicago.
Rich, Chas. Clayton, Mt. Vernon, N. Y. (Rich Electrical Heating Company).
Rogers, J. Harris, Bladensburg, Md.
Ries Electric Specialty Company, The, Eutaw and Baltimore streets, Baltimore, Md.
Roessler & Hasslacher Chemical Company, The, 73 Pine street, New York City.
Rauscher, John, 134 Concord street, West St. Paul, Minn.
Robinson Machine Company, Altoona, Pa.
Ringler, F. A. & Co., 21 Barclay street, New York City.
Riker Electric Motor Company, The, 45 York street, Brooklyn.
Ries, Elias E., corner Baltimore and Eutaw streets, Baltimore Md.
Rosseau's Electrical Works, 310 Mott avenue, New York City.
Sperry Electrical Mining Machine Company, The, Thirty-ninth street and Stewart avenue, Chicago.
Standard Underground Cable Company, Westinghouse Building, Pittsburgh, Pa.
Sponholz, Carl L., 126 School street, Lowell, Mass.
Short Electrical Railway Company, The, Cleveland, O.
Swan Lamp Manufacturing Company, The, Cleveland, O.
Standard Paint Company, The, 2 Liberty street, New York City.
Striemer, A., Hayward, Wis.
Sigler, Jas. O., Paterson, Passaic County, N. J.
Steward Manufacturing Company, The D. M., Chattanooga, Tenn.
Strowger Automatic Telephone Exchange, The, 301 The Rookery, Chicago.
Sample, H. C., 145 Ontario street, Chicago.
Sarony, H. J., 4 Liberty square, Boston.
Stanley Electric Manufacturing Company, Pittsfield, Mass.
Schieren, Chas. A , & Company, 46 S. Canal Street, Chicago.
Standard Electric Signal Company, Rochester, N. Y.
Short Electric Railway Company, The, Cleveland, Ohio.
Standard Battery Company, 324 Dearborn street, Chicago.
Sanden Electric Company, The, 169 La Salle street, Chicago.
Stoelting, Christ. H., 62 South Canal street, Chicago.
Thermo Electric Heat Regulating Company, Easton, Pa.
Thomson-Houston Electric Company, Lynn, Mass.
Ticonderoga Machine Company, Ticonderoga, N. Y.
Thomson Electric Welding Company, Fiske Building, Boston.
Todd, John T., Newman, Ill.
Thompson & Robertson, 258 Broadway, New York City.
Tompkins, Mrs. Jennie E., 2408 Wabash avenue, Chicago.
Tropical American Telegraph Company, The, 15 Cortlandt street, New York City.
Tate, 209 W. Van Buren street, Chicago.
Utica Electric Manufacturing and Supply Company, Utica, N. Y.
Union Electric Works, 207 S. Canal street, Chicago.
Vetter, J. C. & Co., 214 East Forty-seventh street, New York City.
Vail, Stephen, 18 Cortlandt street, New York City.
Viaduct Manufacturing Company, Hermann and Charles street, Baltimore, Md.
Western Electric Company, 327 Clinton street, Chicago.
Weston, Wm. H. & Co., 830 Filbert street, Philadelphia, Pa.
Writing Telegraph Company, P. O. 1322, N. Y. City.
Washburn & Moen Manufacturing Company, Worcester, Mass.
Waterhouse Brothers, 302 Asylum street, Hartford, Conn.
Western Electrician, 6 Lakeside Building, Chicago.
Weston Electrical Instrument Company, 114 Williams street, Newark, N. J.
Westinghouse Electrical Manufacturing Company, Pittsburgh, Pa.
Western Union Telegraph Company, Chicago.
Wing, L. J., 126 Liberty street, New York City.
Waddell-Entz Company, The Bridgeport, Conn.
Webb, Dr. G. F., 251 The Arcade, Cleveland, Ohio.
Wiesinfeld, Robt. South, 2 South Holiday street, Baltimore, Md.
Woods, Granville T., 138 Liberty street, New York City.
Zucker & Levett Chemical Company, 40 Murray street, New York City.

An Elevated Electric Railway in Paris.

A syndicate of engineers has applied for the privilege of constructing an elevated railroad in Paris to be operated by electricity. The project divides the city into two parts by a line running north and south. A new street, 165 feet in width, will be built, which will open into the principal quarters, the Bourse, the Halles Centrales, the Palais du Senat, and the Jardin des Plantes. The central part of this route will be reserved for the elevated line, which will have two tracks resting upon four rows of iron columns, 23 feet in height. The projected line will connect with the Metropolitan railway and with the important lines which already exist.

"P. & S." Single Cleat.

The cleat which is shown in the accompanying cut is manufactured by Pass & Seymour, Syracuse, N. Y. It is designed to be used where wires are required to be separated more than 2¼ in. It holds the wire very firmly without injuring the insulation in the least. There is no lateral strain on the screw, as all the clamping pressure is on the



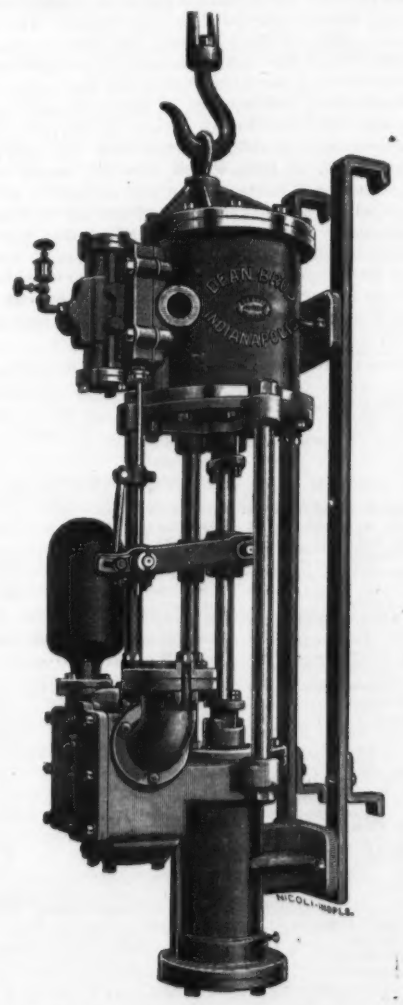
"P. & S." SINGLE CLEAT.

inclined surface of the insulator. There are slight projections on the under side, which are not shown in the cut, to prevent the insulator from turning. A short screw or nail may be used in the hole in cases where there is a tendency to turn. This cleat is strong and durable, and at the same time is neat in design and finish. George Cutter, 329 The Rookery, Chicago, is the Western agent.

Dean Brothers' Steam Pump.

This pump is intended for use in mines, shafts, wells, quarries, pits or reclaiming flooded mines, or in any place where a portable pump is required. It is a single cylinder, direct-acting pump, occupying but little space. Being double acting it throws a continuous stream of water, and can be operated suspended by a hoist or attached to the side of the shaft. In either case it works equally well.

It has the company's new noiseless valve gear with adjustable stroke, which has proven to be one of the best devices yet invented for operating the valves of steam pumps. They are made with a view to withstanding the rough usage to which they are subjected, and are suitable for permanent use in mines. When required the



DEAN BROTHERS' STEAM PUMP.

water cylinder is made of gun metal or bronze to resist the action of bad mine water. The pumps are made in a variety of sizes and combinations. All pumps are made under consecutive numbers and all parts are made interchangeable and are thoroughly tested and inspected before leaving the shops.

The pump shown in the illustration has steam cylinder 14 inches in diameter, pump cylinder 8 inches diameter, stroke 12 inches, suction 6 inches, discharge 5 inches. The Dean Brothers' Steam Pump Works, of Indianapolis, Ind., manufacturers of these pumps, make 500 varieties and combinations of steam pumps.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Nov. 19, 1892.

The General Market.—The one absorbing topic of speculation in Wall street this week was the possibilities of gold exports. Since Monday exchange has been creeping dangerously near the gold exporting point. With plenty of money on the other side and the balance of trade in our favor, exports at this time of year would indicate unmistakably a distrust of the United States as a field for investment. This so forcibly expressed would undoubtedly put a damper on speculation. Toward the close talk of exports was a little less pronounced, and gave rise to the belief that the European demand would grow easier. The bank statement made a most satisfactory showing. The surplus reserves were increased $1,882,025, against a decrease of two weeks ago. Money was plenty in loan markets and obtained 5½ per cent. on good collateral. Rates were generally easier throughout the West. The general business situation is excellent, and makes promise of a continuance. In Wall street the features were the campaign of the bears against the industrials, based on the belief that the incoming administration would enact favorable laws, and the weakness of the railroads under heavy selling based on expected gold exports. The general strength of the closing indicated that next week would chronicle a bull market.

ELECTRICAL STOCK MARKET.

In general none of the securities in this list was active. Holders were inclined to wait until the market settled before doing any trading. The talk of "anti-trust" legislation had its effect in a small way. Of the stocks enjoying minor activity American District Telegraph sold at 58, a loss of 1½ points, and American Telegraph and Cable at 85¼ to 87. Commercial Cable was not traded in, neither were the Westinghouse securities.

Western Union.—This stock led a remarkably even career around 98⅛. Transactions were below the average and it was plainly evident that holders and traders generally are playing a waiting game, in anticipation of the scrip dividend of 10 per cent. The books closed to-day, and the first transactions were 90, ex-dividend, against a closing last night of 98¾. Upon subsequent transactions it went off to 89⅞. Thus it will be seen that the quotations were in discount of the dividend, even before one was seriously expected by the public. There is another point which investors do not seem to have taken into account. The increase in the stock from $86,200,000 to $100,000,000, or $13,800,000, increases by 17 per cent., the amount of stock on which a dividend is to be paid hereafter; heretofore the stock paid 6 per cent. on $86,200,000 and at the same time laid by a surplus. With the additional stock the same earnings will represent but 5 per cent. If the stock sold around 90 on the strength of 6 per cent. and a heavy surplus, it cannot be expected, under the same conditions, to sell at the same figure when there are nearly $14,000,000 more of it. To be sure artificial support may be rendered which will keep up the price. Viewed from an investor's standpoint it will go to 80.

General Electric.—This stock showed a declining tendency throughout the week. It was due to the action of the company in floating another lot of its 5 per cent. debenture bonds. It will be remembered that at the time of consolidation it was authorized to issue $10,000,000 in 5 per cent. debenture bonds. At the time but $4,000,000 were issued. These carried rights to stockholders to subscribe at 95, and were convertible into stock at 120. The bonds had a rapid advance, selling as high as 105¼. The new issue gives holders of 50 shares of stock the right to subscribe to a $500 bond at par. On the basis of the bond quotation before the last issue was made, rights would add $25 to the value of 50 shares of stock, and would undoubtedly sent the quotation up instead of down had the Street regarded the issue as favorable. The contrary was true, as is evidenced by quotation of 112¼, which was the lowest reached for some weeks. The bonds in circulation also sold off to 103, and it is predicted they will go still lower. The officers of the company are extremely reticent in regard to the use to which this $6,000,000 is to be put. From semi-official sources we learn it is to be used in betterments and extensions, and it is assumed that a considerable portion of it will go into railway enterprises. The bearish tendency of the week had its effect upon the stock. In a good bull market we look for an advance.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Nov. 19, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	58	58	58¼	59½
American Tel. & Cable..	100	14,000,000	85½	87	84	86
Central & So. Am. Tel....	100	6,000,000	....	....		....
Commercial Cables.....	100	7,716,000	....	....	168	175
Gold Stock & Tel	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	..	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.... ...	100	85,199 852	*87⅞	99¼	98¼	98¾
Real estate bonds.....	1,000	1,219,000	....	....	....	
Debenture bonds.....	1,000	1,920,000	....	....	....	....
Collateral Trust 5's....	1,000	8,181,000	101⅛	101⅝	....	....
North American.....	100	39,767,200	12	13¼	13	13⅜
Brush Ill. Co. of N.	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	107½	109	107½	109
" " 1sts	...	.....	109½	109⅞	...	
" " Deb's.....	...	.....	....	....	...	....
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....		65
General Electric	1,000	50,000,000	112½	114⅞	112⅝	112¾
Debenture 5's		.....	103	104½	....	....
Automatic Exhibition Co. ...		2,500,000	....	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E & M. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....		....
E. & M. Co. Assg.....	50	5,038,116	....	....	....	....

*Ex dividend.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago.....	214	..	Chicago Arc Light & Power Co.....	102	104
Central Union	....	58	Chicago Edison Co....	170	..

Edison Electric Illuminating.—On Monday this stock sold at 109. Subsequent sales brought it down to 107¼. It is a non-speculative security and any medium sized order either to buy or to sell affects the price; 5,000 of its first five bonds sold at 109½ to 109⅞.

North American.—This stock showed unusual activity, which is reflected in the price which went to 13¼ from 12. There was current no particular news concerning the property.

The Copper Market.—The lake copper market is very strong at 12c. for immediate delivery. No contracts are being taken. When lake navigation closes and stocks now on hand in the East are disposed of, the increase in all-rail freight over that of lake and rail, or about one-half cent, will undoubtedly be added to the cost. We understand that freights will be the same as last year, viz., 63 cents per 100 lbs. to New York from the mines. This is against 17 cents lake and rail. A number of the companies say that unless the rate is reduced they will carry their copper over till spring; that they can do this at about one-eighth cent per pound The statistical condition of copper abroad is improving, the stocks in consumers' hands are light, and the Anaconda is about to close down for three months, shutting off 5,000,000 pounds of copper per month. Altogether the outlook from the producer's standpoint if very promising.

WALL STREET NOTES.

Delinquents.—Among the corporations who are in default upon city taxes are the following: Consolidated Telegraph and Electric Subway Company, $65,766; Standard Gaslight Company, $47,579; Southern Boulevard Railway Company, $2,216; United States Illuminating Company, $2,789 39.

A Consolidation Possible.—A Philadelphia dispatch says that the electric railways of the Lackawanna and Wyoming valleys, including the Carbondale Traction Company, the Scranton Traction Company, and the Wilkes Barre & Wyoming Valley Traction Company may be consolidated. It is stated that Harrisburg, Carlisle and New York capitalists are behind the proposed deal.

The New Incandescent Lamp.—December 1st is the date on which the Westinghouse Company promised its patrons a new incandescent lamp. As the time approaches considerable interest is manifest as to the nature of the lamp's construction and its probable degree of efficiency. It is made of more than one piece, the stopper being of glass and removable. Because of this device it is claimed that the Edison patent is not infringed upon. In appearance the lamp is very much like the one now in use. It still retains the vacuum and filament. The Edison people say in a general way that it must possess other and different component parts in order to be a non-infringment. Here the matter rests pending its appearance. We are informed that orders for the lamp are plenty and that it is insured an extensive use.

Electricity the Cheaper.—The annual report of the West End lines in Boston showed the cost of operation of its horse car lines to have been 83.2 per cent, while the cost of its electric lines was only 60 04 per cent.

The Traction People Enter the Electric Field.—The controlling stockholders of the Atlantic avenue lines, Brooklyn, which comprises 13 miles of double track road, have sold out at $125 per share, against a par of $50, to Messrs. E. W. Clarke & Co, of Philadelphia, and J. & E. Seligman & Co., of New York, representing the Metropolitan Traction Company. The sale carries with it the trolley franchise.

The Right Man.—It is rumored on the Street that Mr. Henry Villard, so prominently identified with electric affairs, will be United States Minister to the Court of Berlin. The appointment would confer honor upon the incoming administration and be most acceptable to the Court of Berlin.

Official and Conclusive.—The following issued by President A. B. Chandler of the Postal Telegraph Company is self-explanatory: "Rumors to the effect that the Western Union Telegraph Company has purchased, or will soon purchase or control, the Postal Telegraph-Cable Company, have been and are being circulated by stockbrokers and others, evidently for speculative purposes. This is to assure our patrons and the public that no consolidation, purchase, or any other arrangement, by which the Postal Telegraph Cable Company ceases to be an absolutely independent and competing telegraph system has been made or is contemplated. The Postal company has during the past five years had an unprecedented growth. It has pursued a businesslike and a straightforward policy. It has not only greatly improved the handling of its own business, in speed, accuracy and form, but it has made it necessary for its great and only competitor, the Western Union Company, to adopt similar methods in order to hold business. All this is greatly in the interest of the public, which has hitherto recognized these facts, and has favored us with a liberal patronage. We are striving to retain and to increase this by the merit of our work, not by tricks in rates and rebates which mean certain ruin, and rely upon our friends of the past and the public in all its branches for its continued support."

Westinghouse's Business.—An exchange says:—"The Westinghouse Electric securities have been very quiet in the Pittsburgh and Boston markets during the past two weeks, but this cannot be said of the business of the company. The latter continues to receive large orders. It has on its payrolls at the Pittsburgh factories 2,000 men, and during this week operations will be begun in the old Air Brake Works in Alleghany. The output for October was at the rate of about $7,000,000 per annum. The company has its apparatus on over 200 street railways, including railways in nearly all of the important cities of the United States. One of the most interesting features in connection with the business is the growth of the electric lighting branch, which during the past two months has been larger than ever before in the history of the company. Work on the manufacture of the new lamp is pushed, and orders are received from all parts of the country, indicating that this new branch of the business will be of very large magnitude."

BOSTON, Mass., Nov. 19, 1892.

The general market for the week may be characterized as a bear market pure and simple, and everything has had to give way under the influences of the bear party. As soon as the election was decided, a rush was made against trust stocks and all industrials, on the supposition that the new administration would seriously affect their business. This theory met with very little credence, and the stocks soon touched bottom and reacted. Then the bears attacked the railroad stocks, and they yielded by great losses throughout the list. So all the principal stocks have been in the hands of raiders and been worked according to their whims. The short interest is becoming very large in the active stocks, and a reaction will soon be due. In fact the closing for the week seems to show evidence of this already. Copper stocks have been more active than usual and at better prices, showing a net gain in all cases for the week. Osceola and Boston & Montana have led in point of activity, and for these stocks much better figures are prophesied. The money market is easier than ever, due to the large supply and slight demand. Banks willingly make time loans, and thereby show an evident opinion that a tight money market is not imminent. Rates have touched the point where the subject of the exchange of gold with London is again a factor, but no shipments are ordered yet. Boston is noticeably turning its funds into New York funds, and creating a large reserve there. Money loaned at the clearing house freely at 4 per cent. and a little at 3½ per cent. Business loans are at 4½ to 6 per cent.

The electric stocks have had an active week, not free from fluctuation or devoid of interest. General Electric has had its first active week for a long time. Between 115 at the opening of the week and 112¾ the stock shows a net loss of 2¾ points. The preferred stock likewise lost two points to 116. This weakness, if such it is, may be due to the large issue of bonds which has been announced by the company. This $7,000,000, will make the total issue of $10,000,000 authorized, and it is said that the proceeds are to go for working capital. The common stockholders are given the right to subscribe for the bonds at par, in the ratio of one bond for every five shares held. Hereafter the company will be capitalized for $10,000,000 bonds, $30,067,200 common stock, and $4,130,300 preferred stock. New rumors are afloat, and credited in some quarters, that the consolidation with the Westinghouse Company is again being agitated, and reaching nearer to a conclusion than ever before. The latter company's stock has not been at all active in this market, and prices are practically unchanged. West End Railway stock has been quite active, and pretty well maintained its high figures due to the issue of bonds instead of more stock. This is regarded as a most agreeable plan on the part of the company, and is reflected in the stock. Telephone stocks have been only moderately active. Erie gained a point to 47 on small sales, based on good reports from the company's business and extensions. Bell lost to 205, but a loss of only two points is not significant, and the result of the general market feeling. The Bell company adds $100,000 to the $300,000 that will be expended by the Erie company on extensions of metallic circuits. The long distance service between New York and Chicago will be largely extended through the Erie's territory, from which its income will be considerably increased. Each month's reports are of a steadily increasing business in this company.

The most recent offering of electric bonds is that of Kidder, Peabody & Co., of Boston, who are selling an issue of $3,000,000, 10-year 5 per cent. coupon notes of the West End Street Railway. These are in the form of coupon notes, and were sold by the company to Kidder, Peabody & Co., instead of being mortgage bonds, for it was desirable to evade the unwritten law that mortgage bonds cannot have precedence over preferred stock, and these coupon notes will naturally stand as notes of the company, and have a first claim on interest charges. The recent annual report of the company shows the necessity of providing for the present floating debt of nearly $1,500,000 and raising funds for extended betterments of the property. Owing to the large issue of common stock last summer it was not thought to be good policy to throw more of it on the market, and then, too, since it is expected to pay 10 per cent. dividends, the issuing of notes at 5 per cent makes a great saving to the company, equal to about $110,000 per annum. The company proposes to include in its charges $25,000 per month against this issue of notes, which would be $300,000 per year, or $3,000,000 in the 10 years' life of the notes. This sinking fund will not lie idle, but will go into the plant, and thereby render it equitable at the end of the 10 years to capitalize the amount of these notes by stock. President Whitney plans for this issue of notes to provide for all expenses to Jan. 1, 1894, when it is calculated the entire road will have been rebuilt, equipped with electricity, and all necessary betterments completed, and ther the earnings will be sufficient to take care of necessary construction. The gross earnings for October, the first month of the fiscal year, were $575,145; in October, 1891, they were $540,793 an increase of $34,352. For 12 days in November the gross earnings were $222,539, an increase of $26,390 over last year, or over $2,000 per day. The average increase is about $1,000 per day. The bonds are offered at 104 and interest, at which price they will net 4½ per cent They are dated Nov. 1, 1892, and are payable and deliverable about Dec. 10. Another large offering of bonds is of the Troy City Railroad Company, of Troy, N. Y., by Lee Higginson & Co., of Boston, and Clark, Dodge & Co., of New York City. The total issue is $2,000,000, first consolidated mortgage, 50-year, five per cent. gold bonds, due Oct. 1, 1942, of which they offer $1,800,000 at par and accrued interest. The company controls all the street railway property in Troy, Lansingburgh, Waterford, Cohoes, Green Island and Albia, serving a population of 105,000, and is a consolidation of four companies under the same management as the particularly successful Troy & Lansingburgh Railroad Company. The total length of road is 25 miles, of which all but four miles is operated by electricity, and extensions are now under way to complete the equipment of the entire road. The gross earnings for the year ending June 30, 1892, were $420,000, and the net earnings over $176,000. Reliable information is that both gross and net earnings are increasing at such a rate that with the present extensions completed the company will earn $225,000 net per year.

The Annual Report of the Lynn & Boston Street Railway Company for the year ending Sept. 30 shows the following figures:

		Increase.
Gross earnings.....	$619.266	$25.445
Expenses	522,679	868
Net earnings	$96,587	$24,578
Interest.....	33,859	7,980
Dividends, 8 per cent.....	52,000	12,000
Total charges.....	$85,859	$19,980
Surplus.....	10,728	4,597
Profit and loss surplus.....	$100,594	$21,365

The company during the year increased its capital stock to $700,000, and issued $275,000 five per cent. bonds, making its total funded debt $700,000. Net floating debt is $57,635. It carried 12,103,388 passengers during the year.

Street Railway Reports.—The following are the reports of street railroads in the State as given to the railroad commissioners of Massachusetts:

LOWELL.

Total income	$212,570.30
Total expenses.....	182,423.31
Dividend, 6 and 3 per cent.....	27,000.00
Deficit Sept. 30, 1892.....	11,820.13

UNION (NEW BEDFORD).

Total income.....	$169,471.79
Total expenses.....	130,490.83
Dividend, 5 per cent.....	12,996.00
Deficit Sept. 30, 1892	10,754.75

BOSTON & REVERE ELECTRIC.

Total income.....	$6,568.90
Total expenses.....	6,174.41
Surplus Sept. 30, 1892.....	390.35

WORCESTER (CONSOLIDATED).

Total income.....	$318,472.75
Total expenses.....	255,495 57
Dividend, 2 per cent quarterly.....	28,000.00
Surplus, Sept. 30, 1892.....	37,939.78

SPRINGFIELD.

Total income.....	$333,550.44
Total expenses.....	201,601.67
Dividend, 8 per cent.....	44,000.00
Surplus Sept. 30, 1892.....	38,877.00

Erie Telegraph and Telephone Company's sub companies made a net gain of 196 subscribers in October; total number connected Nov. 1, 14,893. Dividend No. 36 has been paid to 1,449 stockholders.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8¼	9
Thomson-Houston Elec.—Series D	sh	120,000	8	7⅛	7⅞	8
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	10	....	10	....
Westinghouse Elec.—New Com.	..	6,000,000	37⅛	37	37¼	38
Westinghouse Elec.—Pfd.	..	4,000,000	50	49⅛	49¼	50
General Electric	..	30,067,200	115	112¾	112⅞	113¼
" " Pfd	..	4,136,300	118¼	116	117	118
Fort Wayne Elec.	25	4,000,000	12¼	....	12	12¼
Fort Wayne Elec.—Ser. A.	sh	80,000	....	....	7⅞	8
Detroit Elec	20	750,000	5¼	4⅞	4¾	5
West End St. Ry. Co.—Com	50	7,150,000	74	73	73	73¼
West End St. Ry. Co.—Pfd	50	6,400,000	87½	87	87	87¼
American Bell Tel	100	15,000,000	208	206	206½	207
Erie Tel. & Tel. Co.	..	4,800,000	47	45¾	47	....
Mexican Tel. Co.	10	1,280,000	.95	....	.95	1.05
New Eng. Tel. & Tel. Co.	..	10,304,600	59½	...	59¾	61
Tropical Tel. Co.	10	400,000	....	....	....	....

NEW INCORPORATIONS.

Taylor, Goodhue & Ames, of Chicago, Ill., capital stock $50,000, has been formed to manufacture, buy and sell appliances for electrical and general merchandise purposes. Wm. Taylor, Wells Goodhue and H. D. Ames are the promoters.

The E. W. Hill Company, of Cleveland, O., capital stock $25,000, has been formed to manufacture and deal in electrical supplies, etc. The promoters are Ed. W. Hill, N. C. Stevens, Alfred L. Davis, Francis C. McMillin and Evan H. Hopkins.

The Holly Electric Light and Power Company, of Holly, Mich., capital stock $10,000, has been formed to furnish light and power by electricity. Alfred Green, Detroit, Mich; Chas. H. S. Poole, and Fred. W. Poole, of Holly, Mich., are the organizers.

W. H. Gordon Company, Chicago, Ill., capital stock $10,000, has been incorporated to manufacture, patent, construct and sell all kinds of machinery and electrical equipments, etc. Walter J. Gunthorp, Marion E. Moore and Jean Elliott are the promotors.

The Canton Electrical Company, of Canton, O., capital stock $10,000, has been formed to manufacture and deal in electrical machines and appliances, etc. Jas. H. McLain, J. Keller, J. Frank Dougherty, Frank McLain and Frank E. E. Case are the promoters.

The Newark & Granville Electric Light Company, of Newark, O., capital stock $15,000, has been formed to furnish electric light, heat and power. The incorporators are E. Scheidler, F. A. Crane, Herbert Atherton, E. D. Miller, W. C. Christian and Wm. E. Miller.

The Crown Electric Manufacturing Company, of Elgin, Ill., capital stock $25,000, has been formed to manufacture electrical and metal goods. F. J. Mosedale, J. B. Horne, W. E. Edwards, John Schaaf, F. S. Beardslee and W. H. Wilcox are the promoters.

The Nutall Railway Supply Company, Chicago, Ill., capital stock $25,000, has been formed to manufacture and sell all kinds of railway and electrical supplies, apparatus and machinery. The promoters are Ed. H. Harrison, Patrick H. Carey and Ed. A. Groetzinger.

The Warren Electric and Specialty Company, Warren, O., capital stock $15,000, has been formed to manufacture and sell electric machinery and appliances. C. C. McNutt, Jr., Elmer W. Gillmer, Thomas H. Gillmer, Charles B. Selby and F. C. March are the promoters.

The Heine Electric Company, of Portland, Me., capital stock $10,000, has been formed to manufacture and deal in all kinds of electrical, hydraulic and other kinds of machines and tools. Wm. M. Currier, John O. Heine and Frank A. Norwood, all of Lynn, Mass., are the promoters.

The Elwell Sliding Blind Company, of Berwick, Me., capital stock $200,000, has been formed to manufacture and deal in mechanical, electrical and other devices. Mr. Eben F. Thompson, George H. Burtis, Worcester, Mass., and Harry V. Moore, of Berwick, Me., are the incorporators.

The Missoula General Electric Company, of St. Paul, Minn., capital stock $200,000, has been incorporated to do a general electric business with its plants in Missoula county, Mon. H. M. Bylliesby, Howard C. Levis, St. Paul, Minn., and H. W. Turner of Helena, Mont., are the promoters.

The Eighth Street and West Dubuque Street Railway, of Dubuque, Ia., capital stock $100,000, has been formed to construct, operate and sell electric railways, etc. W. H. Doane, L. H. Bigelow, E. P. Griswold, Walter Todd, J. C. Harper, J. R. Lindsay and G. W. Kiesel, Dubuque, Ia., are the incorporators.

The Marietta Electric Light, Heat and Power Company, of Marietta, O., capital stock $30,000, has been formed to produce and supply electric light, heat and power and to construct and operate street railways. A. T. Nye, D. B. Torpy, Thos. Hancock, W. G. Way and T. W. Moore are the incorporators.

The People's Gas and Electric Company, of Little Falls, Minn., capital stock $50,000, has been formed to erect and operate electric and gas works, and supply same for light, heat and power, and to operate street railways, etc. P. H. Gross, J. C. Flynn, C. J. Haines, J. Wetzel, J. Nestor and J. W. Berg, all of Little Falls, are the promoters.

The Mutual Register Company, of Jersey City, N. J., capital stock $50,000, has been formed to manufacture, sell, etc., electrical and other machines for the purpose of registering tickets or other memoranda and keeping a record of the same. Mr. T. W. Smith, E. L. Lithauer, T. R. Kreator, New York City, and B. Fitzgibbon Boonton, N. J., are the incorporators.

The Gillett Electric Company, of Red Bank, N. J., capital stock $250,000, has been incorporated to manufacture and construct mechanical and electrical machinery, instruments, appliances and apparatus, and to deal in same. J. F. Bray, C. F. Gillett, New York City; J. S. Throckmorton, W. T. Corlies and T. Davis, Jr., of Red Bank, are the organizers.

The Clear Lake & Russian River Railway and Navigation Company, of Lakeport, Cal., capital stock $500,000, has been formed to construct and operate an electric or steam railway in Lake and Mendocino counties, 20 miles long. A. Levy, D. W. White, F. W. Gibson, William Gessner, L. Sailor, W. J. Bigerstaff and R. W. Crump, all of Lakeport, are the promoters.

The Merchantville Light, Heat and Power Company, of Merchantville, N. J., capital stock $50,000, has been incorporated to furnish electricity and gas for lighting, heating and power purposes. A. G. Cattell, W. G. Gilbert, John W. Stetwagon, Edw. S. Hall, Chas. E. Zane, Merchantville, N. J.; Edw. A. Armstrong, George Pfeffer, Jr., Camden, N. J., and Andrew H. McNeal, Burlington, N. J., are the organizers.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Nov. 21, 1892.

A Burn-Out.—Crossed wires in the Western Union cable tower at the foot of York street, Jersey City, set fire to the tower on Wednesday afternoon, and burned out 183 of the 185 wires which are connected to the cable that crosses the river to New York. The loss was about $1,000, but the damage was quickly repaired.

Mr. Pierre Duvinage has severed his connection with the Crocker Wheeler Electrical Company, where he had charge of the testing department, and has started in business under the firm name of P. Duvinage & Co., electrical and building contractors, electric light and power plants, and the Duvinage system of anchor plates and post caps for self-releasing beams for anchoring buildings. The general offices are in the Arbuckle Building and the foundry 79 to 85 Bedford avenue, Brooklyn.

Superintendent Crowley to Resign.—James Crowley, superintendent of the Police Telegraph, has announced his intention of resigning from the position which he has held over 32 years. His resignation will probably be handed in at the next meeting of the Board of Police, to take effect on Jan. 1. Mr. Crowley has been connected with the police department for 43 years. Mr. Crowley's successor will be Michael Brennan, at present assistant superintendent of the telegraph office.

The Anglo-American Electric Manufacturing Company has opened offices at 156 Liberty street, New York City. This company will also have a factory located within the city for the manufacture of magneto bells. It will represent the National Electrical Manufacturing Company, of Milford, Conn., and the Anglo-American Union, Limited, of London and New York in the sale of telegraphic and telephonic instruments respectively, in Mexico, Central and South America. Mr. A. De Castro, so long connected with the Western Electric Company as special export agent, is the manager of the company and his long service in this field will prove of great value.

Messrs. Doubleday, Mitchell & Co. are, as usual, moving along in a quiet way. The business that they are securing, however, might be envied by larger houses. Mr. C. D. Doubleday has just returned from a trip through New York State, and in every pocket he had stowed away numerous orders. Mr. H. B. Kirkland, another representative, has lately visited the City of Brotherly Love, and was so successful that he was called home by telegraph, the supply not being equal to the demand. However, this company is now able to fill all orders on flexible conduit, and a full list of their specialties may be seen in the installation at Hammerstein's new theatre, Thirty-fourth street, near Broadway.

The Autumn Meeting of the Magnetic Club.—The autumn meeting of the Magnetic Club was celebrated on Wednesday evening of last week at Morello's on Twenty-ninth street, in this city. Over 100 telegraphers sat down to dinner at 6:30. The annual meeting of the Telegraphers' Mutual Benefit Association on the same day had brought into the city a number of visiting telegraphers from different parts of the country, many of whom took occasion to attend the Magnetic Club dinner. Speeches were made by President Cockey, J. W. Kelley, Mr. Dealey, T. D. Lockwood, Mr. Garwood, Mr. Plum, president of the U. S. Military Telegraphers Corps; Mr. Lloyd, of Chicago; Mr. Willoughby, of San Franscisco, and Mr. Jones, of the Postal Telegraph Company, New York. Most of the vocal music was furnished by Mr. Quinn, while Messrs. Brew, Peckham and Kelly entertained the telegraph men with recitations, imitations, etc.

The American Telephone and Telegraph Company, through Mr. F. J. Hovey, special agent, is arranging most comfortable and attractive headquarters in the Telephone building, 18 Cortlandt street, this city, for the accommodation of its patrons. The main reception room, which is on the second floor, contains about 250 feet of floor space, and distributed conveniently are sofas, chairs, etc., finely upholstered in leather. At one side are the sound proof booths, several in number, while located near them is the attendant who arranges the appointments; a large table stands in the centre of the room, with plenty of stationery for the use of patrons while waiting. The whole is lighted by rows of incandescent lights located around the ceiling, with special lights for the booths. Another large room off from this main one is arranged for the convenience of manufacturers and others who desire, when holding a special meeting in New York, to be in momentary touch with their factories or other special offices. Stenographic service is also to be provided when required. A special elevator will convey patrons direct. Similar conveniencies will be provided at the Chicago offices, which will be located at 105-107 Quincy street, that city.

L. H. H.

PHILADELPHIA NOTES.

PHILADELPHIA, Nov. 19, 1892.

Mr. Erben Search has been absent from the city on business for the past week.

The American Reflector Company, 132 North Fifth street, Philadelphia, Pa., reports business very gratifying.

Mr. George Vallee, of the firm of Vallee Bros., has been ill for the past two weeks. His many friends, however, would be glad to learn of his convalescence.

The Hilles & Jones Co., builders of heavy machine tools, Wilmington, Del., are getting out a new catalogue on a very expensive scale, and one which will be worthy of preservation.

Mr. E. Blanton, of the Howard and Foundry Machine Co., is delighted with the outlook of his new electric elevator, which he expects to place upon the market very shortly. Mr. Blanton reports business more brisk than he has known it for some years.

The Priestman Engine Company has on exhibition at its offices, Nos. 148-150 South Third street, one of its latest improved 5-h. p. oil engines, which is much admired by all who see it. The space occupied by this engine is 56 × 34 inches; height, 35 inches.

The LaRoche Electrical Works, of this city, has just completed the contract for wiring and entire installation of the Winter Circus Building, corner Broad and Cherry streets, this city. This work was not done by Messrs. Pierce & Co., as was erroneously stated in a former issue. Mr. Pierce, however, is doing some wiring for the arc lights of this building. The LaRoche electrical works is one of the busiest firms in this city, as is evidenced by the fact of its refusal of orders, owing to the large amount of business already contracted for. This firm has installed upon the average of eight plants per week for the past four or five weeks; this is exclusive of its large motor business.

Harry S. Smith, of the Harry S. Smith Company, Ltd., electrical contractors, etc., was, previous to his launching out into business for himself, employed by the well known firm of Walker & Kepler, of Philadelphia, having been with that firm for a number of years, and commencing at the bottom rung, through his ability and strict attention to business, he rose to one of the most important positions in the company. Mr. Smith is a bright young man, well known in this city and surrounding country. The company is located at 607 Chestnut street, this city. It handles the Eddy apparatus in isolated plants and is also agent for the Eddy dynamos, Safety Insulated Wire and Cable Company and Packard high grade incandescent lamp, and will keep a stock of general supplies for all systems of electric lighting constantly on hand. This company commences business under circumstances which augur well for its success.

C. H. & H. Stanton is the name of the new firm of electrical contractors and supply dealers located at 132-134 South Third street, Philadelphia. This firm is composed of two brothers, the elder of whom, Mr. C. H., has been in the employ of Mr. Edison at his works in Orange, N. J., for a number of years, and is well known among electrical people. At present this company occupies rooms on the second story of the above address, but on account of the unexpected growth of business, however, it will in a short time remove to more commodious quarters on the ground floor of this building, which will be used as a show and salesroom, and the rear of which will be the company's business office. The basement of this building will be used for storage purposes. These new offices will be fitted up in the most complete modern style. The Stanton Brothers are wide-awake young men, and no doubt will receive a fair share of the business patronage in this section of the country at least.

N. D. W.

PITTSBURGH NOTES.

PITTSBURGH, Nov. 19, 1892.

The Duquesne Traction Company, the largest street railway company in Pittsburgh using electric motors, has just about completed the loop of the Wilkensburg branch of its road at Shady and South Highland avenues. The tracks have already been laid, and within a few days the Duquesne company will have its entire system from Pittsburgh to Williamsburgh, a distance of eight miles, in operation.

The Pleasant Valley Electric Street Railway Company, of Allegheny City, has recently extended its main line from the lower part of Allegheny to Bellevue and Jack's Run. To complete this extension a bridge had to be erected by the company across a ravine near Jack's Run, which is now about finished, and the residents of these districts are greatly pleased with the outlook of very soon having electric rapid transit.

The East End Electric Light Company, of this city, has added one of the latest Westinghouse 4,000 16-c. p. incandescent lamp dynamos to its already large equipment. This machine is driven by a Westinghouse engine. The East End Electric Light Company is one of the oldest in the country and one of the first to adopt the Westinghouse alternating current system for both incandescent and arc lighting. It has a capacity of about 30,000 incandescent lights and nine-tenths of these are distributed among the private residences of the East End, the fashionable portion of the city of Pittsburgh. The service has been so good from the first that electric lights have become very popular. Mr. G. H. Shane is the general manager, secretary and treasurer of the company.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 19, 1892.

Walter K. Freeman, electrician, 53 State street, Boston, has filed a petition in insolvency.

The Electric Gas Lighting Company, of Boston, Mass., is introducing to the trade its new by-pass ratchet burner.

Principal Charles Spaulding recently delivered an interesting lecture on "Electricity" before the Y. M. C. A., of Adams, Mass.

The Newton Rubber Company has moved its offices from 116 Bedford street to the Hancock Building, Devonshire street, where it now occupies a handsome suite of offices on the second floor.

The A. B. Pitkin Machine Company, of Providence, R. I., has established an office at the corner of Oliver and Purchase streets, Boston, Mass., where it will handle a full line of machinery, pulleys, etc.

The Heintze Electric Company has been organized at Portland, Me., with $10,000 capital stock. The officers are: President, F. A. Norwood, of Lynn, Mass.; treasurer, W. M. Currier, of Lynn, Mass.

The Pratt & Whitney Company, of Hartford, Conn., has not passed into the control of an English syndicate, as was erroneously stated last week. The secretary of the company says in reference to the report: "An English syndicate will not buy out our stockholders and will have nothing to do with the reorganization of our company, if it takes place."

The Newport Electric Light Company has elected Cornelius Vanderbilt, Louis L. Lorillard and Theodore A. Havemeyer, the sugar king, directors. This concern furnishes power for the electric cars which were the cause of a bitter strife between the cottagers and townspeople. The strongest objectors to the cars have now the controlling interest in the electric light company.

The Naugatuck R. R. Company at the annual meeting of stockholders elected the following directors: W. D. Bishop, S. S. Dennis, J. A. Sperry, D. W. Plumb, R. M. Bassett, W. D. Bishop, Jr., F. J. Kingsbury, C. E. Brooker, and H. Robertson. At a subsequent meeting of the directors the following officers were chosen President, W. D. Bishop; treasurer, W. L. Squire, of New Haven secretary, Horace Nichols, of Bridgeport.

The Consolidated Electric Manufacturing Company, through its general manager, Mr. Chas. E. Bibber, has contracted with the Albany Street Railway Company, of Albany, N. Y., to supply it with "Lion" brake handles to equip 15 new cars, which it is having built by the Gilbert Manufacturing Company, of Troy, N. Y. Mr. Bibber also informs us that through his advertisement in THE ELECTRICAL WORLD he has formed a very desirable connection in Paris, France, for the sale of his Heymann lamp.

W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 19, 1892.

Mr. J. B. Wallace, of the Electrical Supply Company, Ansonia, Conn., is the guest of Mr. F. S. Terry this week.

Mr. George Cutter has returned from a trip to Boston, Philadelphia and other points, where he closed some arrangements for the handling of his specialties.

Mr. Moran Brooks, treasurer of the Electrical Engineering and Supply Company, St. Paul, Minn., called on friends in Chicago, en route to New York, where he will arrange for the handling of certain specialties.

The Chicago Electric Club will hold its first literary meet-

ing of the season on Monday evening, Nov. 21, when Mr. William M. Willis will present a paper on the "Compound Winding of Generators from a Practical Standpoint."

Mr. A. P. Munning, formerly with the Leonard & Izard Company, of Chicago, later with the Edison company, and later with the H. Ward Leonard Company, of New York City, has returned to Chicago from Anaconda, Mont., and accepted a position with the American Telegraph and Telephone Company, of Chicago.

The Electrical Supply Company's handsome souvenir attracted so much attention at the street railway convention that the entire stock was quickly exhausted, and Mr. Terry has since been mailing this attractive little book to many applicants who forwarded their addresses. Of course it is a work of art, for Mr. Terry has always lived up to the rule that "what was worth doing at all was worth doing well," whether it was entertaining a friend or capturing a big order.

The Chicago Edison Company has begun work on a North Side plant to furnish electric light, heat and power. The new power house will be located on the Newberry Library grounds in the rear of the library building on Oak street, between Dearborn avenue and Clark street. Light, heat and power will be furnished to the library and private residences. The big plant at Harrison street and the river is being pushed to completion rapidly. When this plant is finished the North Side power house will be used as a sub-station, drawing on the main station for an extra supply when needed. Next year the West Side will be fitted out with the system. The big station at Harrison street and the river will have a capacity of 35,000 h. p.

An Interesting Display.—At the office of the New York Insulated Wire Company, 80 Franklin street, Chicago, is in operation a novel electric lighting plant. The current is furnished by a Charles E. Gregory dynamo, driven by a Gregory arc motor, and the wires from the dynamo to the lamp are encased in Vulca ducts. The circuits are so laid as to show a complete distributing system of Grimshaw white core wire in Vulca ducts, with all the necessary appliances in the way of junction boxes, fishing boxes, elbows, etc., so that any wire can be disconnected and taken out. Among the novelties in the construction of the plant are the Electrical Engineering and Supply Company's sockets, switches, etc., the Cutter Electrical Manufacturing Company's flexible fixtures, and Sunbeam incandescent lamps. Another source of attraction is an illuminated picture of the grounds and buildings of the World's Columbian Exposition, showing Grimshaw white core wire in Vulca ducts carrying currents to the incandescent lamps.

Mr. J. B. Wallace, of Ansonia, Conn., was sitting in the smoker of the Pullman the other day, when an anti-trolleyite opened a fusillade against the evils of the overhead trolley. Mr. Wallace quickly ascertained that the irate individual was the leading light in the town, and finding how ignorant he was regarding the facts in the case, quickly filled him up with cold truths regarding the advance in values of real estate in every city where an electric street railway had been introduced; the comparative values of steam and electric railway investments; how a poor crop or the building of a parallel line might seriously reduce the stock values of the steam line, while the paralleling of the street railway usually educated the people to ride the more, and if the service was good to ride though going only a few blocks. These and many other points were so nicely and yet so forcibly presented that the old man went home a convert to the necessity, from a business standpoint, of the immediate introduction of the overhead trolley in his town.

Ordinance for an Electric Road.—An ordinance was passed granting right of way to the Chicago, Blue Island & Harvey railway company for a street way, wires and electric conductors in Burr Oak avenue, from the east boundary line of the village of Blue Island to Ashland avenue, thence on Ashland avenue from Burr Oak avenue to 119th street, also on 119th street from the east boundary line of the village of Blue Island to Halsted street, also on 123d street, from the east line of the right of way of the Chicago, Rock Island & Pacific railway to Halsted street, on Halsted street from 123d street to 119th street, on Burr Oak avenue from the west boundary line of the village of Blue Island to the west line of section 27, in Township 37; on Winchester avenue, from Burr Oak avenue to 124th street; thence on 124th street, from Winchester avenue to Wood street; also on Lincoln avenue from Burr Oak avenue to 123d street, also on 126th street, from Winchester avenue to Wood street; also on Wood street, from Burr Oak avenue to 123d street.

The National Brotherhood of Electrical Workers adjourned their second annual convention on Wednesday. The next convention will meet in Cleveland in September, 1893. The main business transacted was the discussion of ways and means to raise the standard of the skill of the men belonging to the union. It is a fundamental principle of the union to avoid strikes and to secure better pay and hours by raising the efficiency of the members of the union. To this end provision has been made to establish local reading rooms and libraries containing text-books on electrical subjects, and to organize a systematic course of discussion of such topics as are of importance in their business. Arrangements were also made to establish a journal which will be of a technical character and keep the members of the union abreast of the times in all matters pertaining to the application of electricity to the mechanical arts. This publication will probably be issued in St. Louis, which is at present the headquarters of the national union. One of the provisions of their constitution makes it an offense punished by expulsion for any member of the union to neglect his work by leaving wires in such shape as to endanger the lives of people who might come in contact with them. The present membership of the order is nearly 10,000, and there are 52 local unions in various cities of the Union. The one in New York City has 700 members, and No. 9 of this city has over 600, it having recently been gaining rapidly. The Brotherhood has affiliated with the American Federation of Labor. Its membership consists of all manufacturers of electrical apparatus and men who put up and construct electric and telephone lines, but does not include telegraph operators. The officers elected for the ensuing year are: Henry Miller (reëlected), grand state president, St. Louis, Mo.; P. F. Haley, first grand vice-president, Jersey City, N. J.; Frank J. Roth, second grand vice president, Kansas, City, Mo.; L. F. Veevis, third grand vice president, New Orleans, La.; J. T. Kelly (reëlected), grand secretary-treasurer, St. Louis, Mo. All the above and the following four constitute the executive committee: P. J. Fleming, Minneapolis, Minn.; Charles Edstrand Chicago; John Dunn, Cleveland, O.; John Allen, Wheeling, W. Va.

F. de L

ENGLISH NOTES.

(From Our Own Correspondent.)

London, Nov. 2, 1892.

Liverpool Overhead Railway.—On Monday last the first train was put on the metals.

Accumulator Traction.—The first fruit of the offer recently made by the Electrical Power and Storage Company to maintain battery cars in working order for a certain percentage of the gross receipts is the announcement on the part of Mr. Radcliffe Ward that his long talked of line of electrical omnibuses will at last come into operation. Mr. Ward makes a humorous excuse for his omnibuses weighing 3¼ tons against 1¾ tons for horse omnibuses by saying he carries his horses inside his omnibuses.

Artistic Arc Light Posts.—The latest type of arc light post now being set up in the main thoroughfares of London is a distinct advance, from the artistic point of view, upon those originally erected, which were unnecessarily heavy, their native ugliness being added to by a series of peg-like excrescences, which were dotted over the pillars to enable the lamp trimmer to reach the carbons. At Oxford I hear the local electric lighting company has been very enterprising, and has gone to Germany to obtain patterns in keeping with the architectural beauties of that university town. As street arc lighting becomes more general in this country it is to be hoped that an entirely new type of lamp post will be evolved, having a less pronounced likeness to a gas lamp magnified several diameters.

Municipal Lighting.—The Bradford Corporation has voted £30,000 toward an extension of their electric lighting system. The Brighton Town Council proposes to light the magnificent sea front of that watering place by arc lights, and to largely extend the area of supply. Last week the foundation stone of the municipal central station at Portsmouth was laid with all due ceremony. The work of laying municipal mains has commenced at Nelson and is nearly complete at Dundee. The local authorities at Barnet, Whitehaven and Lancaster propose to adopt electric lighting. The Town Council of Derry (Ireland) has decided to light the entire town by arc lights, and at Bristol the contract for the central lighting station buildings has been awarded to a local firm for £13,000. The St. Pancras Vestry's central lighting station seems to be a sort of Mecca to all electrically minded local authorities; no municipal committee's report is complete without some eulogistic reference to it; not a week passes without some deputation journeying up to London from some remote part of the kingdom for the express purpose of visiting the St. Pancras Works near Regent's Park.

Electrical Trade Section of the London Chamber of Commerce.—At the last meeting of the Electrical Section Mr. Crompton renewed his protest against the interference of the Board of Trade with the minute details of the electrical industry and a sub-committee was appointed to consider the whole question of Board of Trade interference, a great many hard things being said at the same time about the department. After having thus relieved their feelings with regard to the Board of Trade regulations, the meeting discussed with considerable animation the proposal to introduce regulations of a somewhat extraordinary if not utterly impracticable character, to secure uniformity of prices, and to "protect" the virtuous English manufacturer of good apparatus against his "cheap and nasty" German rival. A protest was also made against the multiplicity of types, which characterizes English apparatus almost alone, and the meeting resolved to do all that it could to introduce something like American and Continental practice in manufacturing only a few leading types of machine and making them fit the exigencies of each case by slight modifications. Thanks to the monopoly of the Edison-Swan Company, our incandescent lamps are not made for every conceivable voltage and every conceivable candle power, as is the case with other electrical apparatus.

Hopkinson Three Wire Patent.—The action brought by Dr. John Hopkinson, F. R. S., against the St. James and Pall Mall Electric Light Company came before Mr. Justice Romer in Chancery Court 3 to-day. The patent which Dr. Hopkinson alleges is infringed by the St. James Company is No. 3,576 of 1882, which was amended on June 22, 1891, the title now being, "Improvements in Distributing Electricity and in Apparatus to be Employed for that Purpose." The patent, as amended, contains only two claims; the first is for a differentially wound galvanometer to be used for the purpose of keeping the potential at a given point on the mains constant. Dr. Hopkinson proposed to carry out this object, not by the use of pilot wires run from a voltmeter at the station to the point in question, but by the use of a galvanometer having one coil placed across the terminals of the generator and another in series with them, the resistance of the two coils being so adjusted that so long as the pressure at the distant point was at its proper value there was no deflection, but the moment this exceeded or fell below its proper amount, either an alarm was rung, resistance brought into action, or the speed of the engine altered. The main claim is the second, which reads as follows: "In a system of electric distribution or supply, the employment of three or more conductors in combination with two or more dynamo machines in series substantially as hereinbefore described .... whether the middle conductor be continuous, or be replaced by an earth return." This claim, provided the St. James Company cannot muster up an anticipation, would seem to be indefeasible. However, I understand that the chief defence will probably be that the St. James Company employs not two machines in series, as described by Dr. Hopkinson, but a single 220-volt machine. This defence may possibly prove valid in law, though it certainly is not so in ethics.

London, Nov. 9, 1892.

Municipal Lighting.—At the meeting of the Belfast Town Council on the 1st inst. it was decided to lay down a 10,000 lamp electric lighting plant, an amendment in favor of a 50,000 light plant being defeated by 21 to 7.

Electric Traction.—The electric cars on the South Staffordshire system are expected to come into operation in the course of a few days. A report has just been made by an eminent tramway engineer to the Plymouth Town Council with regard to the present position and prospects of the tramways of that town, which have just been purchased by the municipality. The report very strongly recommends electric traction.

Cathedral Lighting.—The lighting of St. Stephen's Cathedral at Vienna by means of 12 large hanging arc lamps is being much discussed. From a practical point of view the lighting is all that could be wished, bringing out the details as never before. Architects, however, are arguing that the designers of gothic cathedrals designed them with a view to the light coming in at the windows, and that therefore arc lights close to the roof are, from the artistic point of view, by no means beyond reproach.

Obituary.—The death is announced of Mr. Edward Graves, chief engineer of the telegraph department of the General Post Office. Also of the Duke of Marlborough, who of late years has been prominent in connection with electrical company promotion, he being on the board of two telephone companies, one electric lighting company, one electric manufacturing company and one electric investment company. The Duke of Marlborough came very prominently before the public a few weeks ago, in connection with the floating of the so-called New Telephone Company.

Hopkinson Three-Wire Patent.—After having occupied the attention of the courts for five days, the hearing of the action brought by Dr. John Hopkinson against the St. James and Pall Mall Electric Lighting Company for the infringement of his three wire patent, No. 3,576, of 1882, was adjourned for a week, owing to the defendants introducing entirely new and very important evidence of prior use of the three wire system in an incandescent lamp factory at Glasgow. Dr. Hopkinson's patent, as your readers probably know, is owned by the Westinghouse company. Previous to the introduction of the important evidence, which resulted in the adjournment of the case, the defendant's counsel said that there was nothing in the patent confining it to incandescent lamps, and therefore if he could prove that arc lamps had been used on the three wire system previous to the date of Dr. Hopkinson's patent that would be an anticipation. Several colorable imitations of the three wire system with arc lamps were brought forward, two installations at the Alexandra Palace and Inchicore (Dublin) being cited. It was also contended that the differentially wound galvanometer referred to in claim 1, and intended to be used for ascertaining the potential at a distant point on an electric lighting circuit, was unworkable without modifications (such as had been introduced by the Westinghouse company) when used as suggested by Dr. Hopkinson with alternating currents. In default of proving either of these two points the defendant argued that if the invention was confined to incandescent lamps, there was no subject matter for a patent at all.

News of the Week.

THE TELEPHONE.

The Danish Government has decided to purchase all the private telephones in Denmark.

The Northwestern Telephone Company is putting up a new line between Hastings, Minn., and St. Paul.

THE ELECTRIC LIGHT.

Uvalda, Tex., is to have an electric plant in the near future.

Idaho Falls, Colo., will be lighted by electricity early next year.

The Citizens of Sheridan, Ore., are making efforts to secure electric lights.

Grafton, N. Dak.—The electric light company will soon enlarge its plant.

Webster City, Ia., is outgrowing its electric light plant, and will soon need an extension or a new plant.

The Citizens of East Orange, N. J., are petitioning the township committee to have the streets lighted by electricity.

Hillsdale, Mich., has voted by a large majority to bond the city for $15,000 to erect and maintain its own electric light plant.

Toledo, O.—Collector Waldorf has received authority from the Government to receive bids for the lighting of the government building by electricity.

Topton, Pa.—There is a movement on foot to have the town lighted by electricity. Isaac Eckert, of the Topton furnace, will construct a plant for lighting the furnace and proposes to light the town in addition.

The Chillicothe (Ill.) Water, Electric Light and Power Company at a recent meeting decided to put in an incandescent plant for the commercial and residence circuit, provided that it received a guarantee for 250 lights.

The East Aurora (N. Y.) Electric Light Company has purchased an abandoned salt well and has secured from it a plentiful supply of gas, which it is thought will be sufficient to run the plant. Pipes are being laid to the works.

Owensboro, Ky.—Mr. Gooche, an electrician from Louisville, was recently in the city investigating the practicability of erecting a large electric plant of sufficient capacity to run the woolen mills, the electric light plant, the ice factory, and the new electric street railway line.

A Large Electric Light Station.—The foundation stone of a new electric light station was laid at Portsmouth, N. H., last week, and the estimated cost of the new plant is $300,000. It is proposed to light two miles of the sea wall and four miles of the principal thoroughfares by 2,000 c. p. arc lights.

The New Brunswick (N. J.) Electric Light Company has elected the following officers: President, C. J. Carpender; treasurer, Theo. B. Booraem; directors, C. J. Carpender, John Waldron, P. S. Atkinson, T. B. Booraem and James Deshler. Reports showed the company to be in an excellent condition.

Electric Light in Singapore.—The city contract for gas in Singapore expires Jan. 1, and it is expected that the Sultan will adopt the electric light. The estimated cost of a plant is $350,000. There is already a small Thomson-Houston plant in the city. Jahore is expected to have a plant of 50 arc lights, and the two contracts are to be let at the same time.

The Electric Light in the Navy.—The details of the construction of armored cruiser No. 3, which will be known as the Brooklyn, and of battleship No. 1, for which the Secretary of the Navy has just invited bids, have been completed. The electric lighting plant of the Brooklyn will consist of three sets, each set having an engine and dynamo on the same bed plate, and each dynamo having a rated output of 400 ampères at 80 volts. The total weight of the three sets complete will be about 15 tons. The weight of the whole electrical installation, including dynamos, engines, bed plates, fittings, wiring, stores, and four search lights will be about 40 tons. The battleship will have a plant consisting of four units, each unit having engine, dynamo, and combination bed plate and each dynamo having a rated output of 800 ampères at 80 volts. The total weight of the four units complete will be about 26,000 pounds. The total weight of the entire electric apparatus and fixtures of the ship will not exceed 45 tons.

THE ELECTRIC RAILWAY.

The Atlantic Avenue Railroad Company, of Brooklyn, has been sold to the syndicate including the Seligmans and H. B. Hollins & Co.

Fremont, O.—A company composed of Eastern and local capitalists has been formed, and will immediately undertake the construction of an electric street railway system.

The Directors of the Alexandria & Mt. Vernon Electric Railway at a recent meeting determined to double the capacity of the road as soon as the equipment could be procured.

The Muscatine (Ia.) Street Railway Company has passed into the hands of Seevers & Seevers, of Oskaloosa. An electric line will be constructed to Park Place under contract with the Muscatine Improvement and Manufacturing Company which owns the park.

The Cincinnati, Covington & Newport Street Railway Company has ordered 20 of what are thought to be as handsome palace cars as have ever been run upon a street railway. The cars are built by the Brownell Company, and are to be heated by the system of the Dewey Electric Heating Company. The cars are to be perfect in their appointments, and are likely to attract considerable attention.

Electric heating is making wonderful strides, especially in the direction of the heating of street cars. The Dewey Electric Heating Company, of Syracuse, now warrants the wire in its heaters for five years. The company gives customers a written guaranty, saying that unless the heaters come up to all that is claimed for them they can be returned within sixty days at the expense of the company. The amount of current required for electric heating is considerably less than it formerly was, so that this clean and comfortable method of heating street cars is likely to become still more popular. It goes without saying that increased receipts follow properly heated cars.

New Electric Railway Companies.—The Desplaines (Ill.) Electric Railway Company has been incorporated by W. T. Griffith, S. A. Jacobs and F. E. Brady to provide intercommunication between various towns on the Desplaines River. Full details of the project have not been disclosed, but it is understood that connection will be made with the west terminus of the Metropolitan "L" road for the conveyance of passengers in and out of Chicago. The Pennington & Fuller Electric Company has been incorporated with a capital stock of $1,500,000. Pennington, of air-ship fame, is the promoter. The company expects to get a concession from Chicago Heights for the construction and maintenance of an electric light and street railroad plant. No contracts have as yet been let.

LEGAL NOTES.

License to Sell Patents Implies Authority to Sue in Owner's Name.—The United States Circuit Court decides that a grant by the owner of a patent of an inclusive license to sell the patented article carries with it an implied authority to sue in the owner's name, even against his will, for the *bona fide* purpose of preventing infringement.—(Brush Electric Co. v. Electric Imp. Co. of San Jose, 49 Federal Rep., 73.)

Breach of Contract as to Patents.—Where the right to manufacture and sell a certain patented improvement is dependent upon the performance of a condition of an agreement of transfer, the question of the breach of the condition must be first settled before the federal courts can have jurisdiction of an action to recover damages for the unauthorized manufacture and sale of the articles.—(Routh v. Boyd, U. S. Circuit Court D., Indiana, 51 Fed. Rep., 821.)

False Representations Will Not Avoid Sale of Warranted Patent Right.—The purchase of a patent right cannot rescind the sale on the ground of false representation that the patent was valid and did not interfere with any prior patent, where the contract of sale itself contains an express warranty to the same effect, and an engagement on the part of the grantor to defend at his own expense, all suits for infringement.—(Reeves v. Corning, U. S. Circuit Court D., Indiana, 51 Fed. Rep., 774.)

Construction of a Telephone Line Must Be by Grant or Condemnation.—The Supreme Court of New York held that construction of a telephone line by the erection of poles and the placing of wires thereon, within the limits of a country highway, is an additional burden on the fee, not contemplated in the original appropriation of the land for highway purposes, and the right so to construct such line must be by grant or condemnation proceedings.—(Blashfield v. Empire State Tel. & Tel. Co., 18 New York Supplement, 250.)

Rights of Property Owners Along Telephone Lines.—The Supreme Court of New York holds that a telephone company having constructed its line on a highway, without asking the consent of the adjoining owners, or seeking to acquire their rights by negotiation, on the assumption that it had the legal right to construct its line there, the adjoining owners are not stopped on the ground of acquiescence from setting up their rights in the premises.—(Blashfield v. Empire State Tel. & Tel. Co., 18 New York Supplement, 250.)

Bonds to be Issued at Not Less than a Certain Value.—Where a statute provides that no corporation shall issue bonds for less than a certain per cent. of their value, "and all . . . bonds issued contrary to the provisions of this section . . . shall be void," bonds issued and hypothecated by the corporation issuing them as collateral for a loan without stipulation that they shall be accounted for at not less than that per cent. of their par value are void,—(Pfister v. Milwaukee Electric Ry. Co., Supreme Court of Wisconsin, 53 N. W. Rep., 27.)

Priority of Inventions.—It was shown that one Edwin Holmes, a maker of electric burglar alarms, had insulated his wires with a double layer of fibrous material, each layer being separately painted, and the second layer applied before the first was dry. The Supreme Court of the United States held that, although his purpose were merely to obtain perfect insulation, and not to secure incombustibility, his prior use of this means invalidated the Cowles patent, under the rule that the application of an old invention to a new and analogous use does not involve invention.—(Ansonia B. & O. Co. v. Electrical Supply Co., 12 Supreme Court Rep., 601.)

Rights of a Company to Use the Trolley.—The Superior Court of Errors of Connecticut rules that Gen. St. 3505 providing that the mayor and common council of a city may permit and regulate the use of an improved motive power for drawing cars on any horse railroad, does not allow an electric company, even with the permission of the mayor and council, to propel its cars by the use of overhead wires, where the charter of the company declares only that the company may propel its cars "in any mode that does not involve" the use of such wires.—(Farrell vs. Winchester Ave. Ry. Co., 23 Atlantic Rep. (757.)

Corporations Not Exempt from Taxation.—A corporation authorized by its charter, among other things, "to make purchases and sales of investments in the securities of other companies," if not "organized exclusively for manufacturing purposes;" and the fact that it has for several years been engaged in the manufacture of electrical apparatus and appliances and machinery for the generation, transmission and utilization of electricity, and in no other business, does not bring it within the proviso of such a statute as that of Pennsylvania, exempting from taxation the capital stock of corporations "organized exclusively for manufacturing purposes."—(Commonwealth v. Westinghouse Electric and Manufacturing Company, Supreme Court of Pennsylvania, 24 At. Rep., 1,110.)

Constitutionality of State Laws Regulating Sale of Patents.—A State statute, such for instance as that of Indiana, requiring a person who sells, or offers for sale, patents, to file with the clerk of the proper county a duly authenticated copy of the letters patent, and an affidavit that the letters are genuine and have not been revoked or annulled, and that he has a right to sell the same, is a legitimate exercise of the police power of the State, and is not in conflict either with the section of the Constitution of the United States granting to authors and inventors the exclusive right to their respective writings and discoveries for limited times or with the provision of the fourteenth amendment thereof, which forbids the States to abridge the privileges and immunities of citizens of the United States.—(Reeves v. Corning, U. S. Circuit Court, D, Indiana, 51 Fed. Rep., 783.)

PERSONALS.

Miss Helen L. Phelps, daughter of Mr. George M. Phelps, was married on Thursday of last week, at the residence of her parents in Brooklyn, to Mr. George W. Graham.

Mr. Paul D. Cravath, attorney for the Westinghouse Electric and Manufacturing Company, was married last week to Miss Agnes Huntington, the well-known opera singer.

MISCELLANEOUS NOTES.

Jas. F. Bray & Co., dealer in bells and electrical supplies, have removed to Red Bank, N. J.

The Fulton Electric Supply Company, 35 Fulton street, has recently gotten out a combination cigar cutter and electric lamp.

The Alabama Polytechnic Institute, Auburn, Ala., has opened this year with a large attendance, and the electrical engineering course, which is in its second year, is about the most popular one in the college. The electrical laboratory is well equipped, and Professor A. F. McKissick is able to offer to the students an excellent course in theoretical and applied electricity. The first practical application of the electric motor to farm work in this country was made at this institution.

Instruction in Electricity.—Mr. Henry A. Wiegand, of Johns Hopkins University, Baltimore, Md., is to give a course of lectures on the "Principles and Practice of Electricity" at the Friend's High School, 1001 McCulloh street, Baltimore. This course will extend over a period of three months, and it is intended to meet the wants of those whose business brings them daily in contact with the practical applications of electricity. The instruction will be in the form of lectures entirely, illustrated by experiments, for which ample apparatus has been provided.

Photographs of Lightning.—Mr. W. N. Jennings, at one of the recent meetings of the Franklin Institute exhibited by projecting lantern some photographs of lightning taken by him from a rapidly moving train on the prairie of North Dakota at midnight, August 8, 1892. The first and second, taken broadside from a car window, showed single and double discharges, and telegraph poles in triple outline. The third, taken from the rear platform of the train, showed a single discharge with buildings in quadruple outline. The fourth showed a wonderful discharge in the form of a broad band which was called "sash lightning." All of the photographs seemed clearly to prove that lightning is an oscillatory motion.

Mr. C. Langdon-Davies, 45 Redcliffe Square, South Kensington, S. W., in a recent communication, states that his patents for the phonopore apparatus connected therewith, together with his staff, offices, laboratories, etc., at Faraday House have become the property of the Phonopore Syndicate, which has recently been extended into the Phonopore Company, Limited, and will exploit the Phonopore Telegraph in all countries. Mr. C. E. Spagnoletti is managing director of the company and Mr. Walter Langdon-Davies superintending engineer. Mr. C. Langdon-Davies will now occupy himself with the development of the rapid submarine telegraph, new telephone apparatus, etc.

An Important Combination.—It is announced that the Stilwell & Bierce Manufacturing Company and the Smith & Vaile Company, both of Dayton, O., have combined, and the report is confirmed by Mr. J. M. Duncan, manager of the New York office of the latter company. The new company is incorporated under the laws of New Jersey and capitalized at $1,000,000. The stock is being placed on the market by Henry Clews & Co., of New York. 5,000 shares of preferred 8 per cent. cumulative, and 5,000 shares common stocks, at par value of $100. The directors will be E. R. Stilwell, R. N. King, G. N. Bierce, of the Stilwell & Bierce Company; W. W. Smith, J. H. Vaile and O. P. McCabe, of the Smith & Vaile Company; James B. Clews, of Henry Clews & Co., of New York, and J. R. McIntire, president of the Third National Bank of Dayton, O. Each of the parties to the combination has achieved a world-wide reputation and built up a large business, and the new company starts in with every prospect of great success.

Industrial and Trade Notes.

The Riker Electric Motor Company, 45-47 York street, Brooklyn, N. Y., reports business very active.

Chas. S. Platt, 29 Gold street, dealer in platinum, reports business as very good and plenty of orders on hand.

F. N. Crane, 141 Market street, Newark, N. J., contractor and dealer in electrical supplies, reports business as very active.

Chas. D. Rupert, Manager of the Delaware Hard Fibre Company, Wilmington, Del., reports recent large sales of his fibre.

John Acton, 191-193 Worth street, New York City, manufacturer of the Acton pressure regulator, is about to issue a new catalogue.

Mr. A. Leofred, Quebec, Canada, mining engineer, is kept busy all the year around making assays or preparing reports on American and Canadian mines.

Messrs. Huebel & Manger, 286-290 Graham street, Brooklyn, N. Y., are issuing a new catalogue. They are flooded with orders, a large number of which are for contracts in Canada.

H. J. Jaeger, 173 Pearl street, New York City, is now completing large orders for automatic mercury vacuum pumps, and is also engaged in experimental work upon incandescent lamps.

Chas. Heinel & Co., of Wilmington, Del., manufacturers of motors and commutators, make a specialty of the latter, and have sufficient orders on hand to keep them busy for some time to come.

The Dahl Electric Company, 120 Liberty street, New York City, finds it difficult to fill the large number of orders which have been coming in lately for the "Success" arc lamp. The company expects to have a manufacturing plant in operation at Paterson, N. J., in about two weeks.

A Correction.—In referring to contracts which the Mather Electric Company had secured it was erroneously stated in last week's issue that Paul T. Kenney was the agent of the company in New York. This was a mistake, as Mr. Kenney is only a special agent under the jurisdiction of the New York office.

The Wright Universal Electric Company is now manufacturing primary or storage batteries for piano and banquet lamps, for the outfits of physicians and miners, for the propulsion of street cars, sewing machines, yachts, carriages, etc., for bicycle and reading lamps, dental intruments, ventilating fans, etc.

The Baehr Electric Company has removed from 292 to 286-290 Graham street, Brooklyn, where it has secured much larger and more convenient quarters. It is equipping its factory with the newest and latest machinery. This company recently furnished the Third District Edison station, Brooklyn, with several of its well known switches of a capacity of from 700 to 1,600 ampères.

The Knapp Electric Works, 54-56 Franklin street, Chicago, Ill., has sent out its "Illustrated Price List of Electrical Appliances for Incandescent Lighting" for November, and it presents a very attractive appearance. All those who have once used the Knapp apparatus need no introduction to its merits and its circle of aquaintances is constantly enlarging.

The Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa., is sending out several catalogues descriptive of the various apparatus handled by it. The Wharton-Harrison safety boiler is too well known to need any further notice here. This company also handles the Cochrane feed-water heater and purifier, which has found great favor and been widely introduced.

Messrs. Queen & Co., Philadelphia, Pa., have granted a license to George Cutter, of Chicago, to sell a new line of voltmeters and ammeters, which will be known as the Cutler non-inductive instruments. These instruments come under the Cardew patent, which is the property of Messrs. Queen & Co., and which covers all measuring instruments that make use of the expansion of a wire by heat.

Harry S. Smith Company, Ltd., has recently been awarded the contract of wiring and lighting the Hotel Metropole, of Philadelphia, Pa. This hotel will contain 1,500 lights and three directly coupled ventilating sets. The system of calling bells will be the well known Teleseme, its first introduction in that city. It is said this is the largest plant in the city. Thomson-Houston apparatus will be used.

The Esmond Street Railway Company, of 106 Broadway, New York, is sending out a report of Robert Grimshaw which in conclusion says: "I consider the Esmond rail design submitted as promising results superior to those obtainable from any other which I have seen for strength, economy, durability and general adaptability to street railway purposes, and particularly desirable for use in connection with electric traction."

Messrs. Watson & Stillman, New York City, have received a large order for hydraulic projectile drawing presses from the United States Projectile Company of Brooklyn. Orders for hydraulic presses, pumps and accumulators have been so abundant during the past year that Messrs. Watson & Stillman have found it necessary to operate their plant both day and night notwithstanding increased facilities in the several departments.

H. M. Sciple & Co., Philadelphia, Pa., dealers in engines and boilers, have within the past week, been awarded a contract from the Coatesville Electric Light and Power Company, of Coatesville, Pa., for supplying power as follows: One 66 × 18 feet butt strap joint boiler stack; Weston automatic engine with pump, heater, etc., complete; also one Weston automatic engine and 50-h. p. boiler for Belcher electric light plant, Philadelphia.

The Berlin Iron Bridge Company, of East Berlin, Conn., has taken the contract for a new machine shop to be built at Newport News, Va., for E. C. Hillyer & Co. The building will be 82 feet in width, divided into a central portion 40 feet between crane girder columns, with a wing on each side 21 feet in width. The wings will be two stories high, the balcony floor being used for light work. The central portion of the building will be controlled by a 20-ton traveling crane.

The Huyett & Smith Manufacturing Company, Detroit, Mich., manufacturer of dry kilns, brick dryers, ventilating fans, exhaust fans, blowers, engines, boilers, etc., has issued its general catalogue No. 27. The apparatus of this company is widely known and its merits generally recognized. The heating and ventilating of shops, factories, public buildings and residences is constantly coming into more common practice, and the Huyett & Smith company make complete installations of apparatus for this purpose.

The General Electric Launch Company, 44 Broad street New York city, has entered the field of building and equipping electric launches, and is prepared to furnish craft of any style and finish desired, or of any size from 20 to 100 feet in length. This company is the sole licensee for marine purposes of the Consolidated Electric Storage Company, whose patents were recently sustained by the United States Court of Appeals. The motors and other electrical devices are especially constructed by the General Electric Company.

The Electrical Supply Company, Chicago, general Western agents for the Stanley transformers, has recently closed contracts for immediate delivery to one of the largest alternating stations in the West for 690 transformers, amounting to over $45,000. The Stanley transformers are to replace those at present in use, and the exchange, it is said, was made on account of the small leakage current of the Stanley, showing a saving in operating expenses so great as to make it economical to throw out the old transformers and substitute new ones. Such a sale is certainly strong evidence in support of the superiority of the Stanley transformer.

Messrs. Waterhouse Bros., of Hartford, Conn., are sending out to the trade the following circular: "We take pleasure in announcing that we have associated with us, under the firm name of Waterhouse, Gamble & Co., Mr. James N. Gamble, of Cincinnati, O., well known as vice-president of the Proctor & Gamble Company, and Mr. Wm. J. Partridge, of New York City. The office of the firm, Room 176, No. 45 Broadway, New York, will be under the management of Mr. Partridge, and the factory will remain at Hartford, Conn." Waterhouse, Gamble & Co. are also sending out a circular calling attention to their improved arc lamp for arc and incandescent circuits, electric meters, etc,

Mr. James F. Cummings, of the firm of Cummings & McCoy, Detroit, Mich., has been for some time working out a complete underground system for the transmission of currents for long distance service. The company now guarantees to transmit successfully from 50,000 to 100,000 volts from Niagara Falls to Buffalo, either as a simple alternating current over one bare copper wire, or on the multiple system. The Cummings patent underground system has been laid in Detroit for the Detroit Electric Light and Power Company, and the bare copper wires have been found to work satisfactorily, carrying there about 1,500 volts. The same system is also being installed in an Edison plant in St. Paul, Minn.

The Pennsylvania Electric Engineering Company, of Philadelphia, Pa., is sending out a handsome lithograph (by Geo. W. More, Philadelphia) of the Philadelphia & Reading terminal in Philadelphia. This building is eight stories high, occupies four city squares, is constructed of granite, terra cotta and brick and will cost in connection with the elevated tracks about $10,000,000. It will be perhaps the finest building of its kind in the world, and one of the best public buildings in the country. The Pennsylvania Electric Engineering Company is installing the complete electric light plant, which will consist of Western arc and National incandescent apparatus. Ten Western dynamos will supply 300 Western arc lamps distributed over the building.

Edward C. White & Co. is the name of a new firm which will conduct the business hitherto carried on by Edward C. White under the name of the Globe Iron Works, at 556 West Thirty-fourth street, New York City. Edward C. White and William D. MacQuesten are the two partners of the new company, which will manufacture tools of every kind, street car wheels for horse, cable and electric roads, etc. This concern has a special four-wheel truck known as the "West End" truck and has furnished 120 of them to the West End road of Boston, and is now constructing 400 more,

They also make the "West End Radial" truck, which is meeting with great favor, and have a number of orders on hand for a special form of electric snow plow and electric turn tables.

The National Electric Manufacturing Company, Eau Claire, Miss., has received from C. E. Woods, inspecting engineer, the following results of test upon its transformers: "Transformer test, Nov. 1, 1892, for comparison as to efficiency on 1,000 V. × 100 V. transformer. Transformer No. 9,880—Primary load, 1.844 ampères, secondary load, 18.220 ampères; efficiency, 98.76 per cent. Transformer No. 9,882—Primary load, 1.895 ampères; secondary load, 18.220 ampères; efficiency, 96.09 per cent. Transformer No 9,921—Primary load, 1.853 ampères; secondary load, 18.220 ampères; efficiency, 97.29 per cent. Temperature of above three tests made with iron heated to 90 deg. F. Efficiency given with full load plainly shows that they give the highest efficiency of any transformer tested." The Pennsylvania Electrical Engineering Company is the Philadelphia agent of this company.

The Standard Electric Time Company, of New Haven, Conn., has contracted with the Cheney Bros., of South Manchester, Conn., to put in one of its new striking electric tower clocks, and a system of 48 electric dials, including the railroad depot and town hall. This will give South Manchester a uniform system of time that will be greatly appreciated. A contract has also been signed for a large time plant, including an electric tower clock, in the school for the deaf and dumb at Fulton, Mo. This is the third institution of this kind to adopt the Warner system of electric time within a few months. The De La Vergne Refrigerating Machine Company, of New York, are also to adopt the Warner system, which is to displace another electric system which has not given satisfaction. The electric tower clock made by this company, although a comparatively new thing, has given such general satisfaction in the past two years that it is taking the place of the old wind-up clock where fine time is required.

Warren Webster & Co., 491 N. Third street, Philadelphia, Pa., patentees and manufacturers of the Webster vacuum feed water heater and purifier, and licensees, for the sale of patent rights of the Williams vacuum system of steam heating report the following orders during the month of October: David Lupton's Sons,' Philadelphia, Pa.; Lord & Taylor, New York; Armour & Company, Chicago; Chicago Malleable Iron Works, Chicago; Boughen Engineering Company, Cincinnati, O.; Jas. McClurg & Co., Pittsburgh, Pa: M. H. Crane, Cincinnati, O.; Lalance & Grosjean Manufacturing Company, Harrisburg, Pa.; Frahar & Brother, Brooklyn, N. Y.; Apollo Iron and Steel Company, Apollo, Pa.; Roaring Spring Blank Book Company, Roaring Spring, Pa.; Pennsylvania Railroad Company, Union Depot, Pittsburgh, Pa.; Pennsylvania Steel Casting and Machine Company, Chester, Pa.; Remington Paper Company, Watertown, N.Y.; Armour & Company, Kansas City, Mo.; Botsford Paper Mill Company, Kalamazoo, Mich.; M. Price, Newark, N. J.; Risdon Iron and Locomotive Works, San Francisco, Cal.; Chas. Kaestner & Co., Chicago, Ill.; Maryland Steel Company, Sparrow's Point, Md.; Commonwealth Hotel, Harrisburg, Pa.; Harrisburg Foundry and Machine Company, Harrisburg, Pa.; Crompton Company, Quidnick, R. I.; American Fire Engine Company, Seneca Falls, N. Y.; Royal Weaving Company, Pawtucket, R. I.; Pennsylvania Steel Company, Steelton, Pa., this last order being for 8,250 h. p.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

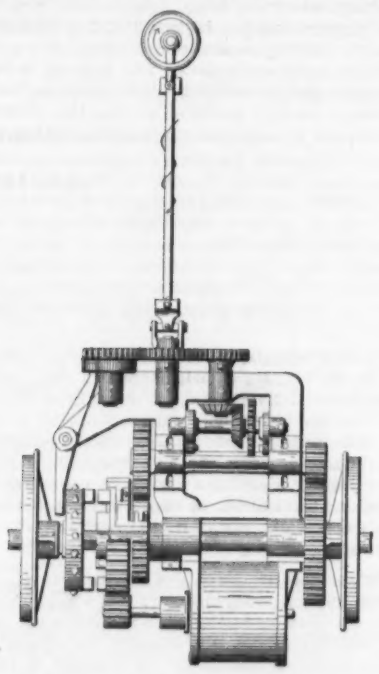
UNITED STATES PATENTS ISSUED NOV. 15, 1892.

486,068. Electric Locomotive; William E. Allington, East Saginaw, Mich. Application filed June 9, 1891. In a motor for street car propulsion, the combination, with a compound-wound motor and speed and power gears for gearing the motor to the driving axle and a regulating handle for throwing either speed or power gear into gear at will, of a switch likewise operated by the motion of the regulating handle and adapted to vary the speed and power of the motor by throwing in or out of circuit the series coil or coils of the motor. (See illustration.)

486,078. Armature for Dynamo-Electric Machines and Electric Motors; Charles S. Bradley, New York. Application filed Nov. 17, 1890. A drum armature having a slotted core and a series of coils fitted in the slots, the individual strands or windings of the coils having substantial parallelism throughout one side of each coil lying beneath the opposite side of the next coil in sequence, so that all are bound together.

486,094. Secondary Battery; Rudolf Eickemeyer, Yonkers, N. Y. Application filed April 4, 1890. In a secondary or storage battery, the combination of a suitable cell or receptacle and battery plates arranged in a pile, insulated from each other, each plate having openings through it from the side and each of the openings registering with corresponding openings in the other plates and affording spaces for occupation by the battery fluid.

486,123. Electric Meter; John Perry, London, England. Application filed June 8, 1892. An electric meter consisting of a rotary circular body, in combination with means for sending a current from its edge to its centre, or vice versa, and means for producing Foucault currents in the body. (See illustration.)



No. 486,068.—Electric Locomotive.

486,149. Test Circuit for Burglar Alarm Systems; Edmund R. Wilder, Kansas City, Mo. Application filed Aug. 22, 1891. This invention consists of a series of outlying station signaling devices with a central station apparatus connected therewith, a tester at the central station containing a movable arm and a series of contact plates adapted to be successively engaged by such arm, a circuit containing all of such plates and the arm, a series of magnets, one at each outlying station and included in the circuit, armatures, one for each magnet, a retracting spring and dog connected with each armature, a ratchet wheel adapted to be engaged by such dog and to be rotated one tooth at each action by the spring, a pin on the plate, a local starting circuit for the station signaling mechanism, and a circuit closer therefor in the path of the pin, the ratchet wheels arranged so that each will move one tooth at each action and one of the local starting circuits will be closed at each action.

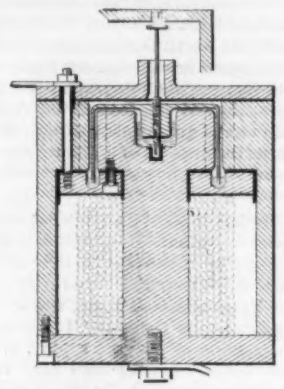
486,176. Electric Forge; George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Jan. 12, 1892. An electrode for an electric forge, consisting of a base, a fixed jaw supported thereon, an arm pivoted to the base and provided with a hook at its outer end having a depressing cam face and a lifting cam face, a movable jaw supported by the arm, and a lever pivoted to the base and provided with a stud engaging the cam faces when the lever is oscillated.

486,206. Police Signal System; John Cornelius Wilson, Boston, Mass. Application filed Oct. 14, 1887. In a municipal telegraph system comprising a main office and several substations or boxes connected by a single wire, the combination of circuit changing devices contained in the boxes for transmitting signals, a receiving instrument at the main office for receiving the signals from the boxes, with light signals and electro-magnets controlling their operation, and electro-magnetically movable step-by-step individual call switches controlling the circuits of the light signal-operating magnets, and a circuit changing device at the main station for effecting the movement of the switches whereby two independent systems of communication are effected over one wire between the main and the several substations.

486,212. Circuit-Controllers; Harry W. Leland, Jersey City, N. J. Application filed Jan. 11, 1892. This invention comprises a sheet or disc of elastic material provided with one or more protuberances formed on its surface and circuit controlling contacts embedded in the sheet and its ridges.

486,213. Governing Electric Motors; Robert Lundell, New York. Application filed Dec. 19, 1891. An electric motor having two or more circuits, each of which circuits includes in series a section of coils on the field magnet, in combination with circuit changing devices for varying the series and multiple arc relation of the circuits.

486,214. Governing Electric Motors; Robert Lundell, New York. Application filed Jan. 2, 1892. The combination of three or more conductors between different pairs of which different electromotive forces are maintained, a motor having two or more armature coils, and an equal number of field-magnet coils, circuit-changing devices for connecting the motor at will between different pairs of conductors and circuit changing devices for altering the relation of the field magnet and armature coils.



No. 486,123.—Electric Meter.

486,215. Double Snap-Switch; Robert Lundell, New York. Application filed Feb. 10, 1892. The combination, in a switch, of a body, several rows of contact plates thereon, pivoted springs or plates adapted to co-operate therewith, means for moving the body and for putting a spring under tension thereby, and means for releasing the spring, and a striker moved by the spring against the pivoted contact plates or springs.

486,234. Armature for Dynamo-Electric Machines; Albert L. Parcelle, Boston, Mass. Application filed Nov. 7, 1891. The combination of an armature ring having apertures or seats therein for the armature coils and coils lying in the seats, the coils each composed of a cable of insulated wires whose ends are electrically connected to form a continous circuit through the coil.

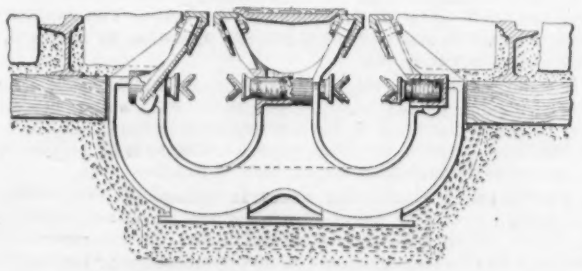
486,243. Electrical Annunciator; Franklin S. Carter, Burlington, N. J., and George P. Stumpf, Philadelphia, Pa. Application filed Aug. 13, 1891. In an electric annunciator, a pointer which also acts as an armature, in combination with a differential magnet acting thereon and having two helices which develop different strengths of current when energized, two push buttons arranged at different points for call and return call, a generator of electricity, conductors making circuits, respectively, through each of the helices, and the appropriate push buttons and bells included in the circuits, respectively, the devices being so arranged that the current sent through the larger helix on pressing one push button is of opposite polarity to that sent through the smaller helix on pressing the other.

486,244. Microphone; Charles Clamond, Paris, France. Application filed March 21, 1892. A telephonic transmitter comprising two electrodes at a distance from each other, and a plastic viscid conducting body maintained in invariable contact with the two electrodes, the whole included in a charged electric circuit.

486,264. Electric Battery; John J. O'Lalor, Boston, Mass. Application filed Oct. 3, 1891. In an electric battery a circular copper cell having a central post with an insulating sleeve about the post, a circular apertured pad in the cell and a circular centrally apertured zinc disc resting on the pad, the post rising through the apertures, in combination with a circular removable cover having a central terminal and a terminal, adapted to contact with the zinc disc, whereby not only is the circuit closed upon placing the cover in any position on the cell, but the contact can be insured by a partial rotation of the cover.

486,270. Wire-Covering Machine; John A. Barrett, Brooklyn, N. Y. Application filed May 2, 1892. The combination with a hollow rotating shaft through which the conductor or other articles to be wrapped is drawn of a tape-reel carried by and rotating the shaft, devices carried by the shaft for applying fluid to the tape, and connections whereby the devices may be fed from a stationary fluid supply during the rotation of the shaft.

486,282. Messenger-Call System for Buildings; Frank H. Fuller, Springfield, and Charles B. Perkins, Holyoke, Mass. Application filed April 5, 1892. In a messenger-call system for buildings the combination, with a call box centrally located with respect to the rooms of a building or those upon a single floor and electrically connected with a central station, of an indicator adjacent to the call box and adapted to be set to designate either of the rooms.



No. 486,315.—Electric Railway Conduit.

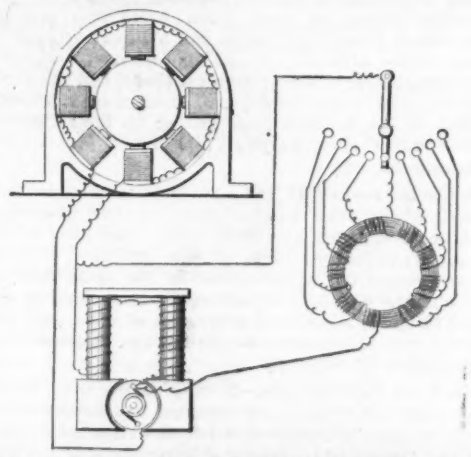
486,315. Electric Railway Conduit; Augustine W. Wright, Chicago, Ill. Application filed May 12, 1892. In a double underground conduit for electric railways, the combination, with the double yoke casting provided with the double series of converging rail supports, so that the inner supports relatively diverge, of angular slot rails seated on and bolted to the supports, the spaces between the inner diverging supports forming openings for access to the conduits at either side, and manholes bearing on the inner slot rails for closing the openings. (See illustration.)

486,321. Electric Switch; Ernest P. Warner, Chicago, Ill. Application filed Feb. 16, 1891. In an electrical switch, the combination with a rocker or cam of two springs having their under surfaces opposite the rocker curved inwardly at the lower portion thereof and provided with a seat or catch, the springs being adapted to be raised or lifted from contacts at their free ends by the action of the rocker or cam, while at the same time the springs are thereby placed in electrical connection through the medium of the rocker.

486,332. Telegraph System; Adolphus Gipperich, Richmond, Va. Application filed July 30, 1892. In a telegraph system, the combination of a series of main line circuits having the terminal contacts there of arranged in annular series, and each contact being independent of the other, a call-sounder in the local circuits of the main line circuits, a rotating contact connected normally in circuit with the call-sounder and arranged within the annular series of the main line terminal contacts, a brush carried by the rotating contact and adapted to successively ride upon the terminal contacts during each complete revolution of the rotating contact and mechanism for positively driving the rotating contact in one direction continuously.

486,333. Trolley for Electric Railways; Augustus H. R. Guiley, South Easton, Pa. Application filed Dec. 31, 1891. In an electric railway a continuous slotted conduit placed at or below the street level, provided with one or more electrical conducting rails, and furnished with sectional hinged covers arranged to open outwardly, one or more trolley rods provided with sectional insulation, arranged to project from the electric car through the slot of the conduit and provided with trolley wheels adapted to roll on the electrical conducting rails, and a hand lever pivotally connected with the trolley-rod for raising and lowering the trolley wheels and increasing or diminishing the pressure of same on the conductors.

486,334. Regular Electric Lamp; George W. Hall and Joseph J. De Marr, Georgetown, Colo. Application filed Dec. 1, 1891. The combination of a lamp socket with a long contact spring and another short contact spring of a lamp provided with carbon filaments of different resistances, these filaments being connected to a contact button at one end and connected with separate contact buttons at the opposite end.



No. 486,417.—Regulator for Dynamo-Electric Machines.

486,338. Electric Alarm; Henry A. Hull, New Brunswick, N. J. Application filed April 20, 1892. An electric alarm provided with a rod mounted to slide and to turn, and carrying a contact pin and a contact spring, provided on its free end with two faces, of which one is insulated, and both faces adapted to be alternately engaged by the contact pin.

486,354. Electric Magnetic Bell; James J. Ross, Detroit, Mich. Application filed Dec. 29, 1891. In an electric bell ringing apparatus, the combination, with two or more electro-magnets, of the armature lever pivoted intermediate the ends thereof between the magnets and carrying a hammer at one end, the bell or bells arranged in proximity to the hammer, the contact springs resting against opposite ends of the other arm or end of the armature lever, and circuit connections normally closed through the armature lever and both of the magnets and contact springs, whereby a continuous bell ringing action is produced by the reciprocal action of the magnets.

486,377. Electric Arc Lamp; Daniel Higham, Boston, Mass. Application filed July 9, 1892. An electric arc lamp provided with carbon feeding mechanism, in combination with a variable resistance connected in series with the carbons and means whereby the variable resistance is acted upon by the current supplied to the lamp through the medium of a yielding connection.

486,394. Apparatus for Recording Speech or Other Sounds; William Bruening, East Orange, N. J. Application filed July 23, 1891. In a phonograph, a style consisting of a loop of an electrical circuit, the two limbs of which are insulated from each other and from the diaphragm, and the end of which loop is provided with a suitable point for making the record in a phonograph record blank.

486,399. Workman's Time Register; Charles J. J. Carnett and Alfred Moore, Keighley, Eng. Application filed Oct. 20, 1891. In a time checking mechanism, the combination of a rotary disc, check-receptacles mounted thereon, a motor weight acting on the disc, electromagnets, armatures acted on by these magnets, and engaging with the disc, and means for intermittently moving the disc at prearranged times.

486,417. Regulator for Dynamo-Electric Machines; Application filed March 29, 1891. The combination of a dynamo electric machine with field magnets whose coils are traversed by a pulsating current with an exciter for such field magnets, and a regulator adapted to vary the current in the field responsive directly to the varying range of pulsation of such current, and the field magnets and regulator being independent of the main working circuit. (See illustration.)

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.